CDD-880

Multi Receiver Router
Installation and Operation Manual

For Firmware Version 1.1.1 or higher

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding these products. Product specifications are subject to change without prior notice.

Part Number MN-CDD880 Revision 0

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Multi Receiver Router
Installation and Operation Manual

For Firmware Version 1.1.1 or higher

Part Number MN-CDD880
Revision 0
October 11, 2010

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PREFACE

About this Manual

This manual provides installation and operation information for the Comtech EF Data CDD-880 Multi Receiver Router. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CDD-880.

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Technical Publications Department:

TechnicalPublications@comtechefdata.com

Conventions and References

Metric Conversion

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing non-Metric to Metric conversions.

Recommended Standard Designations

Recommended Standard (RS) Designations have been superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations may be shown when depicting actual text displayed on the Web Server (HTTP) or Command Line Interface pages for the unit (e.g., RS-232). All other references in the manual will be shown with the EIA designations.

Trademarks

Product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

IMPORTANT

The user should carefully observe the following information.

Cautions and Warnings

IMPORTANT

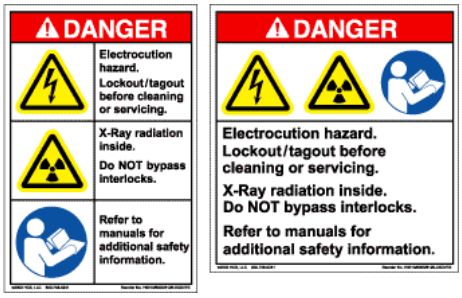
IMPORTANT ***or*** **NOTE** ***indicates a statement associated with the task being performed or information critical for proper equipment function.***

CAUTION

CAUTION ***indicates a hazardous situation that, if not avoided, may result in minor or moderate injury.*** **CAUTION** ***may also be used to indicate other unsafe practices or risks of property damage.***

WARNING

WARNING ***indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.***


DANGER
Electrocution hazard. Lockout/tagout before cleaning or servicing.
X-Ray radiation inside.
Do NOT bypass interlocks.
Refer to manuals for additional safety information.
DANGER
Electrocution hazard. Lockout/tagout before cleaning or servicing.
X-Ray radiation inside. Do NOT bypass interlocks.
Refer to manuals for additional safety information.

Examples of Multi-Hazard Formats

Electrical Safety and Compliance

The CDD-880 has been shown to comply with the **EN 60950 Safety of Information Technology Equipment (Including Electrical Business Machines)** safety standard.

The equipment is rated for operation over the range 100–240 volts AC or, appropriately equipped, 36–60 volts DC. It has a maximum power consumption of 245 watts.

Fuses

CAUTION

FOR CONTINUED OPERATOR SAFETY, ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING.

The CDD-880 is fitted with **two (2X) 20mm Slow-blow** type fuses:

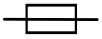
- For 230/115 Volt AC standard router operation, use 2.5A fuses. These fuses – one each for line and neutral connections – are contained within the body of the IEC power inlet connector behind a small plastic flap.

- For 48 Volt DC standard router operation, use 3.15A fuses. These fuses are contained within individual screw-in receptacles on the CDD-880 rear panel, below the terminal blocks.

Low Voltage Directive (LVD)

The following information is applicable for the European Low Voltage Directive (2006/95/EC):

Symbol	Description
<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung

International Symbols			
Symbol	**Definition**	**Symbol**	**Definition**
	Alternating Current		Protective Earth
	Fuse		Chassis Ground

For additional symbols, refer to* Cautions and Warnings *listed earlier in this Preface.

Installation

The installation and connection to the line supply must be made in compliance to local or national wiring codes and regulations.

The CDD-880 is designed for connection to a power system that has separate ground, line and neutral conductors. The equipment is not designed for connection to power system that has no direct connection to ground.

The CDD-880 is shipped with a line inlet cable suitable for use in the country of operation. If it is necessary to replace this cable, ensure the replacement has an equivalent specification. Examples of acceptable ratings for the cable include HAR, BASEC and HOXXX-X. Examples of acceptable connector ratings include VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, BS1636A, BSI, SETI, IMQ, KEMA-KEUR and SEV.

Environmental

The CDD-880 must not be operated in an environment where the unit is exposed to extremes of temperature outside the ambient range 0° to 50°C (32° to 122°F); precipitation, condensation, or humid atmospheres above 95% relative humidity; altitudes (unpressurized) greater than 2000 meters; excessive dust or vibration; flammable gases; or corrosive or explosive atmospheres.

Operation in vehicles or other transportable installations that are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed.

Telecommunications Terminal Equipment Directive

In accordance with the Telecommunications Terminal Equipment Directive 91/263/EEC, this equipment should not be directly connected to the Public Telecommunications Network.

CE Mark

Comtech EF Data declares that the CDD-880 meets the necessary requirements for the CE Mark.

RoHS Compliance

This unit satisfies (with exemptions) the requirements specified in the European Union Directive on the Restriction of Hazardous Substances, Directive 2002/95/EC, (EU RoHS).

EMC (Electromagnetic Compatibility) Compliance

In accordance with European Directive 89/336/EEC, the CDD-880 has been shown, by independent testing, to comply with the following standards:

Emissions: EN 55022 Class B – Limits and methods of measurement of radio interference characteristics of Information Technology Equipment.

(Also tested to FCC Part 15 Class B.)

Immunity: EN 55024 – Information Technology Equipment: Immunity Characteristics, Limits, and Methods of Measurement.

Additionally, the CDD-880 has been shown to comply with the following standards:

EN 61000-3-2 – Harmonic Currents Emission.

EN 61000-3-3 – Voltage Fluctuations and Flicker.

To ensure that the CDD-880 continues to comply with these standards, observe the following instructions:

- Connections to the L-Band Rx port (Type ‘N’ female connector) should be made using a good quality coaxial cable.
- All 'D' type connectors attached to the rear panel must have back shells that provide continuous metallic shielding. Cable with a continuous outer shield (either foil or braid, or both) must be used, and the shield must be bonded to the back shell.
- The equipment must be operated with its cover on at all times. If it becomes necessary to remove the cover, the user should ensure that the cover is correctly refitted before normal operation commences.

Warranty Policy

Comtech EF Data products are warranted against defects in material and workmanship for a specific period from the date of shipment, and this period varies by product. In most cases, the warranty period is two years. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective. Repairs are warranted for the remainder of the original warranty or a 90 day extended warranty, whichever is longer. Contact Comtech EF Data for the warranty period specific to the product purchased.

For equipment under warranty, the owner is responsible for freight to Comtech EF Data and all related customs, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the owner. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

All equipment returned for warranty repair must have a valid RMA number issued prior to return and be marked clearly on the return packaging. Comtech EF Data strongly recommends all equipment be returned in its original packaging.

Comtech EF Data Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

Limitations of Warranty

The warranty does not apply to any part of a product that has been installed, altered, repaired, or misused in any way that, in the opinion of Comtech EF Data Corporation, would affect the reliability or detracts from the performance of any part of the product, or is damaged as the result of use in a way or with equipment that had not been previously approved by Comtech EF Data Corporation.

The warranty does not apply to any product or parts thereof where the serial number or the serial number of any of its parts has been altered, defaced, or removed.

The warranty does not cover damage or loss incurred in transportation of the product.

The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech EF Data Corporation, such as lightning or other natural and weather related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

The warranty excludes any responsibility by Comtech EF Data Corporation for incidental or consequential damages arising from the use of the equipment or products, or for any inability to use them either separate from or in combination with any other equipment or products.

A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech EF Data Corporation cannot identify the cause of the reported failure.

Exclusive Remedies

Comtech EF Data Corporation's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

Customer Support

Refer to p. xiii in this Preface for information regarding this product's Warranty Policy.

Contact the Comtech EF Data Customer Support Department for:

- Product support or training
- Reporting comments or suggestions concerning manuals
- Information on upgrading or returning a product

A Customer Support representative may be reached during normal business hours at:

Comtech EF Data
Attention: Customer Support Department
2114 West 7th Street
Tempe, Arizona 85281 USA

480.333.2200 (Main Comtech EF Data number)
480.333.4357 (Customer Support Desk)
480.333.2161 FAX

To return a Comtech EF Data product (in-warranty and out-of-warranty) for repair or replacement:

- **Contact** the Comtech EF Data Customer Support Department during normal business hours. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.
- **Request** a Return Material Authorization (RMA) number from the Comtech EF Data Customer Support representative.
- **Pack** the product in its original shipping carton/packaging to ensure that the product is not damaged during shipping.
- **Ship** the product back to Comtech EF Data. (Shipping charges should be prepaid.)

Online Customer Support

An **RMA number** can be requested electronically by accessing Comtech EF Data's online **Support** page (**www.comtechefdata.com/support.asp**). From this page:

- **Click** the **Service** hyperlink, then read the **Return Material Authorization** section for detailed instructions on Comtech EF Data's return procedures.
- **Click [Send RMA Request]** on the **Support** page or the **RMA Request** hyperlink provided in the **Service | Return Material Authorization** section; fill out the *Billing Information*, *Return Information*, and *Unit to be Returned* sections completely, then click **[Send email]**

  – or –

- **Send an e-mail** providing this same detailed information to the Customer Support Department at **service@comtechefdata.com**.

Notes:

Chapter 1. INTRODUCTION

1.1 Overview

Figure 1-1. CDD-880 L-Band Multi Receiver Router

The CDD-880 Multi Receiver Router (**Figure 1-1**) supports from two through 12 independent demodulators (expandable, by pairs, on a single card) in a single 1RU chassis. The CDD-880 is intended to serve as a hub expansion utility device for Comtech EF Data's Advanced VSAT Series product offering.

CDD-880 features include:

- 2, 4, 6, 8, 10, or 12 fast acquisition demodulators/decoders, each supporting operation up to 4.5 Msps
- Easy field upgradability, if shipped with less than 12 demodulators/decoders
- Programmable from 950 to 2150 MHz (L-Band)
- Comtech EF Data VersaFEC Forward Error Correction
- **(FUTURE)** GZip decompression
- **(FUTURE)** 1:1 Redundancy capability
- LNB Support – 10 MHz reference and LNB power
- As an IP-only packet processing device, it requires no direct implementation changes in support of its multi-point RAN Optimization functionality
- With 12 demods all able to receive up to 15 Mb of compressed packets (30 Mb uncompressed), the LAN interface can receive as much as 360 Mb of data

1.2 Functional Description

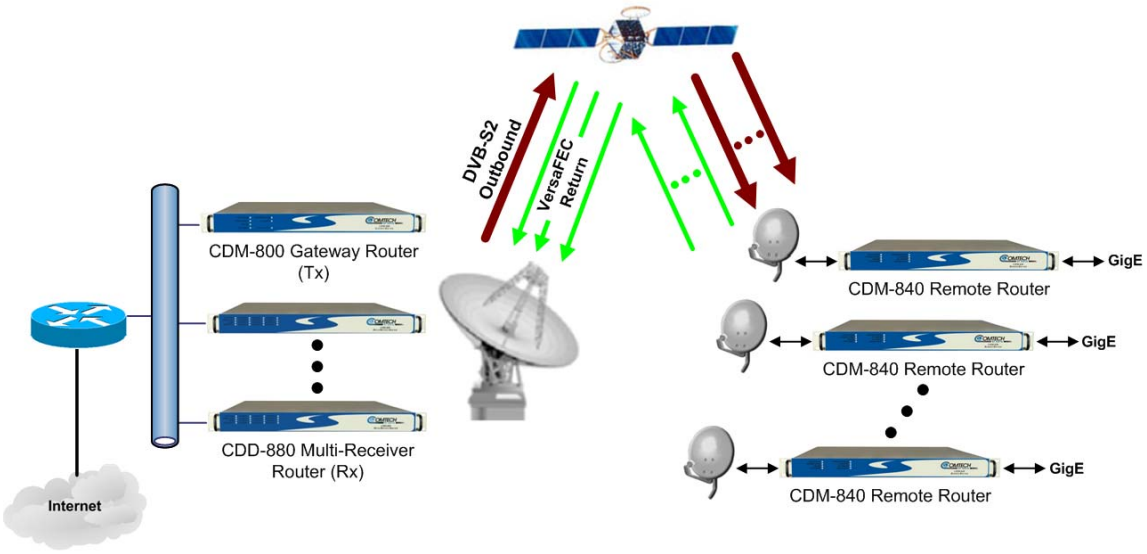


Figure 1-2. Advanced VSAT Series Network Topology Example

Figure 1-2 illustrates the CDD-880 Multi Receiver Router as deployed in a typical satellite-based communications network – in this example, a Hub-and-Spoke IP Network.

The CDD-880 Multi Receiver Router features six plug-in cards, each of which supports two VersaFEC/Streamline demodulators. This allows for six deployed configurations: 2, 4, 6, 8, 10 and 12 demods.

Overall, the receive path allows IP packets to be Streamline decapsulated, K4 decompressed if required, and then sent to the processor. IP packets are sent out the appropriate Ethernet interface. Optimized E1 packets will be received with IP/UDP headers and routed to the appropriate CXU-810 RAN Optimizer on the hub network.

Note: As IP/UDP packets, the CDD-880 is completely agnostic/ignorant to the RAN Optimization feature, which offers significant network feature simplicity advantages.

The CDD-880 receive path has the following characteristics:

- 256 IPv4 static routes
- 256 Static ARP entries
- Streamline-compatible decapsulation
- VersaFEC compatible for all MODCODs
- **(FUTURE)** Header decompression
- The receive path is compatible with a CDM-840 for all features
- Routing Only (no bridge mode)

1.3 Features

1.3.1 Physical Description

The CDD-880 Multi Receiver Router is constructed as a 1RU-high rack-mounting chassis, which can be free-standing if desired. Handles at the front to facilitate removal from and placement into a rack.

The unit uses a single printed circuit board assembly for high reliability. All operational upgrades and enhancements are afforded via remote firmware upgrade.

1.3.1.1 Standard Assemblies

Assembly	Description	Where Installed
PL-0000772	CDD-880 Base Chassis Assembly (AC)	–
PL-0000763	CDD-880 Main PCB	CDD-880 chassis
PL-0000764	CDD-880 Dual Demodulator Board	CDD-880 chassis
FS-0000030	Cartridge Fuse, 2.5A 250VAC 5x20mm Slow-blow fuse, 213 series	CDD-880 chassis

1.3.1.2 Optional Assemblies

Assembly	Description	Where Installed
PL-0000866	CDD-880 Base Chassis Assembly (DC)	–
KT-0000168	4” Rear-Mounting Support Bracket	Sides of CDM-840 chassis / rear of user-provided mounting rack – See Sect. 2.2.1
KT-0000195	10” Rear-Mounting Support Bracket	

1.3.2 Compatibility

The CDM-880 receives VersaFEC interoperable with Comtech EF Data’s CDM-840 Remote Router, and the CDM-625 Advanced Satellite Modem when equipped with the optional IP Packet Processor.

1.3.3 Dimensional Envelope

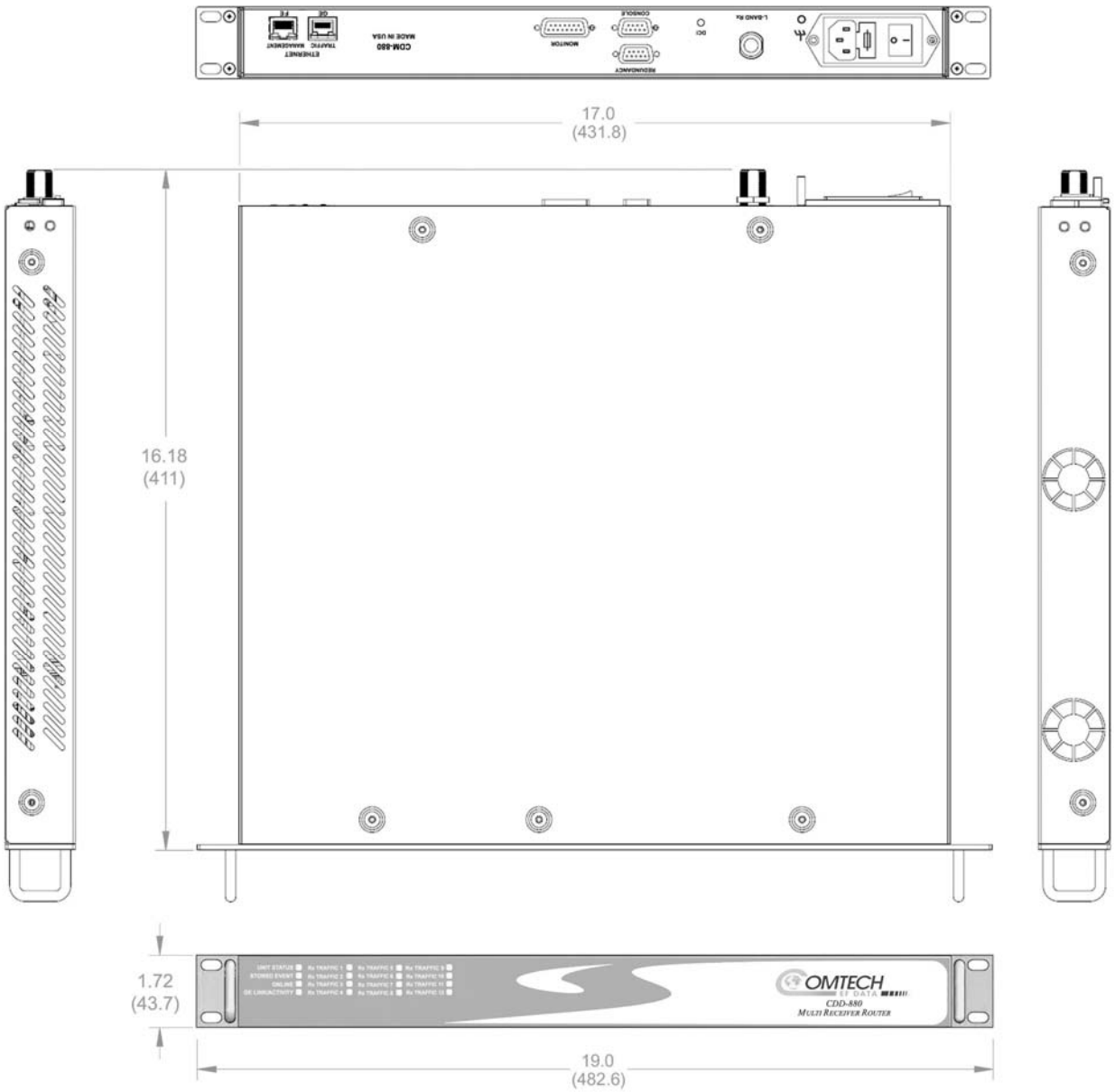


Figure 1-3. CDD-880 Dimensional Envelope

1.3.4 Physical Features

1.3.4.1 Front Panel

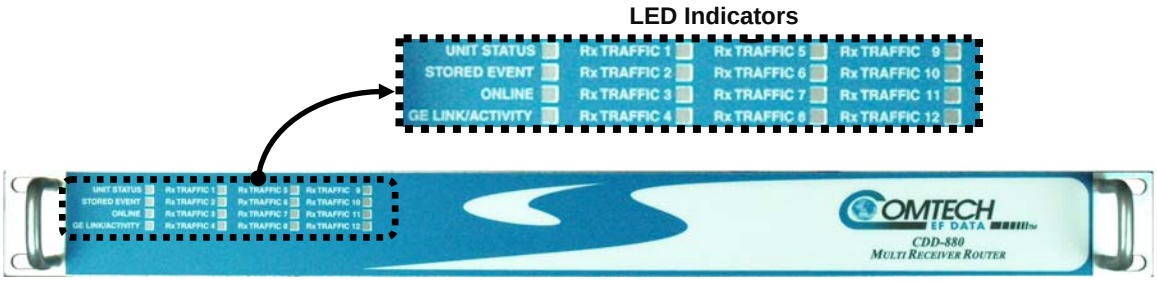


Figure 1-4. CDD-880 Front Panel View

Figure 1-4 shows the front panel of the CDD-880. The front panel features 16 **L**ight-**E**mitting-**D**iode (LED) indicators. The LEDs indicate, in a summary fashion, the status of the unit:

- Overall Unit Status
- Stored Event
- **(FUTURE)** Online when in 1:1 Redundant Mode (Online or Offline)
- 10/100/1000 BaseT Gigabit Ethernet (GigE) Activity
- Traffic Status for each of up to 12 Rx Traffic (receive) channels.

Note the following:

LED	Condition	
UNIT STATUS	Green	No Unit Faults or Alarms.
	Amber	No Unit Faults, but an Alarm exists.
	Red	A Unit Fault exists (Example: PSU fault).
STORED EVENT	Amber	There is a Stored Event in the log, which can be viewed from the Web Server Interface or retrieved via the remote control interface.
	Off	There are no Stored Events.
ONLINE	Green	The Unit is On Line, and carrying traffic.
	Off	The Unit is Off Line (standby) – forced by externally connected 1:1 or 1:N redundancy system.
GE LINK/ACTIVITY	Green (solid)	Traffic Ethernet is connected, but no traffic exists.
	Green (blinking)	Ethernet activity detected.
	Off	GE Ethernet port is not connected.
Rx TRAFFIC 1 through 12	Green (solid)	No Rx Traffic Faults (demod and decoder are locked, everything is OK).
	Green (blinking)	No Rx Traffic Faults, blinks when a packet is being received from the satellite link to this unit.
	Amber	Rx Traffic has an Alarm.
	Red	Rx Traffic has a Fault.
	Off	Demod Card is not installed.

1.3.4.2 Rear Panel

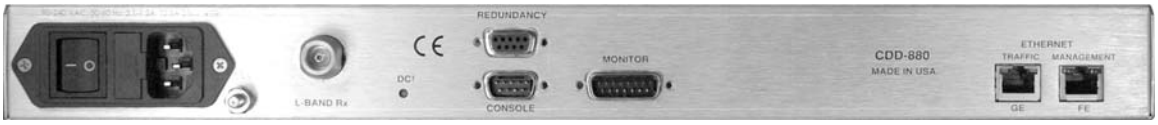


Figure 1-5. CDD-880 Rear Panel View

Figure 1-5 shows the rear panel of the CDD-880. External cables are attached to connectors on the rear panel of the unit. Each connector is described in detail in **Chapter 3. REAR PANEL CONNECTOR PINOUTS**.

1.3.5 Data Interfaces

The CDD-880 includes, as standard, a 10/100 BaseT Fast Ethernet (FE) Interface and a 10/100/ 1000 BaseT Gigabit Ethernet (GigE) Traffic Interface.

1.3.6 Flash Upgrading

The internal firmware is both powerful and flexible, permitting storage and retrieval of up to 10 different configurations. The unit uses 'flash memory' technology internally, and new firmware can be uploaded to the unit from an external PC. This simplifies software upgrading, and updates are deliverable over satellite, via the Internet (using the CDD-880 Web Server (HTTP) Interface), e-mail, or on CD. The upgrade can be performed without opening the unit, by simply connecting the CDD-880 to the Ethernet port of a computer. See **Chapter 4. FLASH UPGRADING** for further information.

1.3.7 Fully Accessible System Topology (FAST)

The CDD-880 is extremely flexible and powerful, and incorporates a large number of optional features. In order to permit a lower initial cost, The CDD-880 may be purchased with only the desired features enabled.

If, at a later date, a user wishes to upgrade the functionality of a demodulator, Comtech EF Data provides **F**ully **A**ccessible **S**ystem **T**opology (**FAST**), which permits the purchase and installation of options through special authorization codes entered into the unit using the CDD-880 Web Server (HTTP) Interface.

These unique access codes may be purchased during normal business hours from Comtech EF Data.

FAST System Theory

FAST facilitates on-location upgrade of the operating feature set without removing a CDD-880 from the setup.

With **FAST** technology, operators have maximum flexibility for enabling functions as they are required. **FAST** allows an operator to order a demodulator precisely tailored for the initial application.

When service requirements change, the operator can upgrade the topology of the CDD-880 to meet those requirements within minutes. This accelerated upgrade can be accomplished because of **FAST**'s extensive use of the programmable logic devices incorporated into Comtech EF Data products.

FAST Implementation

Comtech EF Data's **FAST** system is factory-implemented in the CDD-880. All **FAST** options are available through the basic platform unit at the time of order – **FAST** allows immediate activation of available options, after confirmation by Comtech EF Data, via the remote control interface.

See **Appendix A. FAST ACTIVATION PROCEDURE** for further information.

FAST Accessible Options

Hardware options for basic demodulators can be ordered and installed either at the factory or in the field. The operator can select options that can be activated easily in the field, depending on the current hardware configuration of the CDD-880. A unique access code enables configuration of the available hardware.

The following table shows the available FAST and FAST-accessible hardware options:

Option	Description and Comments	Option Installation Method
Demod Card w/VersaFEC	Up to six (6) dual demodulator cards installable.	Hardware / FAST
Rx Data and Symbol Rate	CCM 1 to 5 Mbps	FAST
	CCM 1 to 10 Mbps	
	CCM 1 to 25 Mbps	
	CCM 1 to 50 Mbps	
	CCM 1 to 75 Mbps	
	CCM 1 to 100 Mbps	

1.4 Summary of Specifications

1.4.1 Demodulator

Specification	Parameters			
Frequency Range	950 to 2150 MHz			
Input	Type 'N' female connector			
Input Impedance	50Ω, 17 dB minimum return loss			
Input Power Range	-130 + 10 log(symbol rate) to -80 + 10 log(symbol rate) dBm (see Figure 1-6)			
Maximum Composite Operation Level	102 – 10 log(symbol rate, desired carrier) dBC, +10 dBm max, with the additional requirement that within ±10 MHz of the desired carrier, composite power is ≤ +30 dBC.			
Absolute Maximum, No Damage	+20 dBm			
Adaptive Equalizer	5-tap design, selectable on/off			
Acquisition Range	Fixed acquisition range of ± Rs/2 = receive symbol rate / 2			
Clock Tracking Range	± 100 ppm min			
Acquisition Range	+/- 100kHz			
Spectral Inversion	Normal or Inverted			
Return Loss	min 18dB (typical 20 dB)			
Receiver Signal Level Monitor	+/- 6dB (typical)			
FEC Mode	VersaFEC – CCM Only			
Decapsulation	Streamline			
Symbol Rate Range	16Ksps to 4.5 Msps in CCM Mode			
Spectral Mask	20%, 25% or 35%.			
Data Rate	6Kbps to 15.35 Mbps and corresponds to symbol rate ranges in CCM Mode			
Modulation and Code Rate	Modulation	Code Rate	Min (Kbps)	Max. (Kbps)
	BPSK	0.488	16.0	2190.0
	QPSK	0.533	18.0	4800.0
	QPSK	0.631	21.0	5670.0
	QPSK	0.706	23.0	6340.0
	QPSK	0.803	26.0	7220.0
	8-QAM	0.642	31.0	8670.0
	8-QAM	0.711	35.0	9600.0
	8-QAM	0.780	38.0	10530.0
	16-QAM	0.731	47.0	13160.0
	16-QAM	0.829	54.0	14910.0
	16-QAM	0.853	55.0	15350.0
Descrambling	V.35 or OFF			
(FUTURE) I&Q Constellation	Via Web Server (HTTP) Interface			
Monitor Functions	• Eb/No Frequency Offset • Corrected BER • Rx signal level • LNB current and voltage			
Data and Management Interface	10/100 BaseT Fast Ethernet RJ-45 port			
Terrestrial Traffic Interface	10/100/1000 BaseT Gigabit Ethernet (<360 Mbps) RJ-45 port			
Command Line Interface (CLI)	EIA-232 via DB-9 REMOTE port			

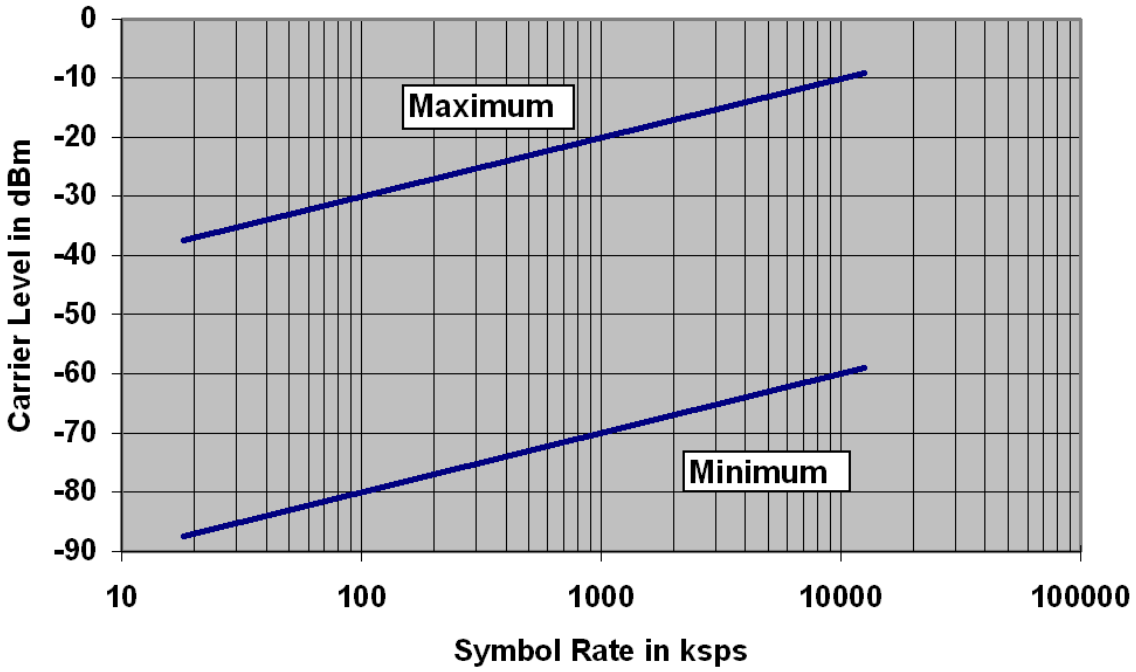


Figure 1-6. Rx Carrier Level vs. Symbol Rate (L-Band 950 – 2150 MHz)

1.4.2 Low Noise Block Converter (LNB) Support

Parameters	Specifications
LNB Voltage	+13 volts, +18 volts per DiSEq, and +24 volts DC at 500 mA maximum
10 MHz Reference	• -3 dBm ± 3 dB via Rx connector center conductor • Source: Either Internal modem reference or External reference • Performance: For phase noise, refer to L-Band modulator 10 MHz. • Frequency Stability: Same as the modulator 10 MHz reference.
(FUTURE) LNB Power Level	Selectable ON or OFF per Rx input (on Rx connector center conductor)
Current Alarm	Programmable minimum/maximum alarms

1.4.3 Environmental and Physical

Parameters		Specifications
Temperature	Operating	32 to 122°F (0 to 50°C)
	Storage	-4 to 158°F (-20 to 70°C)
Humidity	Operating	95% maximum, non-condensing
	Storage	99% maximum, non-condensing
Power Supply	AC	Includes an on/off switch
	DC	Includes an on/off switch and an input filter per PL-0000551 and PL/10312-1 Kits
Operating Voltage	AC	100 – 240 Volts AC +6%/-10% autosensing (total absolute max. range is 90 – 254 volts AC)
	DC	48 Volts nominal (total range is 36 to 60 volts)
Power Consumption		60 W typical
Fuse		120/230 VAC: T3.15A, slow-blow 20 mm 48VDC (38 to 60 VDC): T8.0A, slow-blow 20 mm
Physical Dimensions		1RU high x 19 inches wide x 16 inches deep (43.8 mm h x 482.6 mm w x 406 mm d)
Weight		7 lbs (3.2 kg)
Agency Approvals		CE Mark FCC Part 15, Class B

1.4.4 BER (Bit Error Rate)

VersaFEC CODEC BER BPSK (With two adjacent carriers, each 7 dB higher than the desired carrier)	For: BER=10-5 BER=10-8	Rate 0.488 Guaranteed Eb/No (typical value in parentheses): 2.4 dB (2.1 dB) 2.7 dB (2.4 dB)			
VersaFEC CODEC BER QPSK (With two adjacent carriers, each 7 dB higher than the desired carrier)	For: BER=10^{-5} BER=10^{-8}	Rate 0.533 QPSK Guaranteed Eb/No (typical value in parentheses): 2.3 dB (2.0 dB) 2.5 dB (2.2 dB)	Rate 0.631 QPSK Guaranteed Eb/No (typical value in parentheses): 2.8 dB (2.5 dB) 3.0 dB (2.7 dB)	Rate 0.706 QPSK Guaranteed Eb/No (typical value in parentheses): 3.3 dB (3.0 dB) 3.7 dB (3.4 dB)	Rate 0.803 QPSK Guaranteed Eb/No (typical value in parentheses): 3.8 dB (3.5 dB) 4.1 dB (3.8 dB)
VersaFEC CODEC BER 8QAM (With two adjacent carriers, each 7 dB higher than the desired carrier)	For: BER=10^{-5} BER=10^{-8}	Rate 0.642 8QAM Guaranteed Eb/No (typical value in parentheses): 4.6 dB (4.3 dB) 4.9 dB (4.6 dB)	Rate 0.711 8QAM Guaranteed Eb/No (typical value in parentheses): 5.2 dB (4.9 dB) 5.5 dB (5.2 dB)	Rate 0.780 8QAM Guaranteed Eb/No (typical value in parentheses): 5.6 dB (5.3 dB) 6.0 dB (5.7 dB)	
VersaFEC CODEC BER 16QAM (With two adjacent carriers, each 7 dB higher than the desired carrier)	For: BER=10^{-5} BER=10^{-8}	Rate 0.731 16QAM Guaranteed Eb/No (typical value in parentheses): 6.4 dB (6.1 dB) 6.6 dB (6.3 dB)	Rate 0.780 16QAM Guaranteed Eb/No (typical value in parentheses): 7.0 dB (6.7 dB) 7.3 dB (7.0 dB)	Rate 0.829 16QAM Guaranteed Eb/No (typical value in parentheses): 7.5 dB (7.2 dB) 7.8 dB (7.5 dB)	Rate 0.853 16QAM Guaranteed Eb/No (typical value in parentheses): 8.0 dB (7.7 dB) 8.3 dB (8.0 dB)
Monitor Functions	• Eb/No estimate: 3 to 12 dB with ± 0.5 dB accuracy • Corrected Bit Error Rate: 1E-3 to 1E-9 • Frequency offset: ± 32 kHz range,100 Hz resolution • Signal Strength Indicator: 0-60 dB range relative to maximum gain				

Notes:

Chapter 2. INSTALLATION

2.1 Unpacking and Inspection

The CDM-880 Multi Receiver Router and its Installation and Operation Manual are packaged in a pre-formed, reusable, cardboard carton containing foam spacing for maximum shipping protection.

Be sure to keep all shipping materials for the carrier's inspection.

Inspect shipping containers for damage. If the shipping containers are damaged, keep them until the contents of the shipment have been carefully inspected and checked for normal operation.

Do not use any cutting tool that will extend more than 1" into the container and cause damage to the unit.

Unpack and inspect the unit as follows:

Step	Description
1	Cut the tape at the top of the carton indicated by **"OPEN THIS END.**"
2	Remove the cardboard/foam space covering the unit.
3	Remove the unit, manual, and power cord from the carton.
4	Save the packing material for storage or reshipment purposes.
5	Inspect the equipment for any possible damage incurred during shipment.
6	Check the equipment against the packing list to ensure the shipment is correct.
7	Refer to the following sections for further installation instructions.

2.2 Mounting

If the CDD-880 is to be mounted in a rack, ensure that there is adequate clearance for ventilation, particularly at the sides. In rack systems where there is high heat dissipation, forced air cooling must be provided by top or bottom mounted fans or blowers. Under no circumstance should the highest internal rack temperature be allowed to exceed 50°C (122°F).

IMPORTANT

The CDD-880 may* NOT *have rack slides mounted to the side of the chassis. *Two cooling fans are mounted in the right-hand side of the chassis, with air exhaust venting provided along the chassis' left-hand side. Comtech EF Data recommends that an* ***alternate method of support is employed*** *within the rack, such as rack shelves or CEFD's optional rear-mounting support bracket kits. If there is any doubt, please consult the Comtech EF Data Customer Support department.*

2.2.1 Optional Rear-Mounting Support Bracket Kit

Install the optional rear-mounting support brackets kit KT-0000168 or KT-0000195:

Quantity		Part Number	Description
KT-0000168	KT-0000195		
2	2	FP-0000913	Plate, Adapter
4	4	HW/10-32X3/8FLT	Screw, #10 Flat Head
1	–	KT/6228-2	4" Rear Support Bracket Kit
–	1	KT/6228-3	10" Rear Support Bracket Kit

Additionally, the KT/6228-X Rear Support Bracket Kit, furnished as part of kit KT-0000168 or KT-0000195, contains the following parts:

Quantity		Part Number	Description
KT/6228-2	KT/6228-3		
2	2	HW/10-32SHLDR	Screw, #10 Shoulder
4	4	HW/10-32FLT	Washer, #10 Flat
2	2	HW/10-32SPLIT	Washer, #10 Split
2	2	HW/10-32HEXNUT	Nut, #10 Hex
4	4	HW/10-32x1/2RK	Bolt, #10 Rack Bracket
2	–	FP/6138-2	Bracket, Rear Support – 4"
–	2	FP/6138-3	Bracket, Rear Support – 10"

The tools required for this installation are a **medium Phillips™ screwdriver**, a **5/32-inch SAE Allen™ Wrench**, and an **adjustable Crescent® wrench**.

The kit is installed as illustrated in **Figure 2-1** and per the following procedure:

Step	Description
1	Secure the Adapter Plates to each side of the chassis at the rear, using the #10 flat head screws as shown.
2	Secure the #10 shoulder screws through the Adapter plate mounting slots using the #10 flat washers, #10 split washers, and #10 hex nuts as shown.
3	Install the rear support brackets onto the equipment rack threaded rear mounting rails, using the #10 rack bracket bolts.
4	Mount the unit into the equipment rack, ensuring that the #10 shoulder screws properly engage into the slots of the rear support bracket.

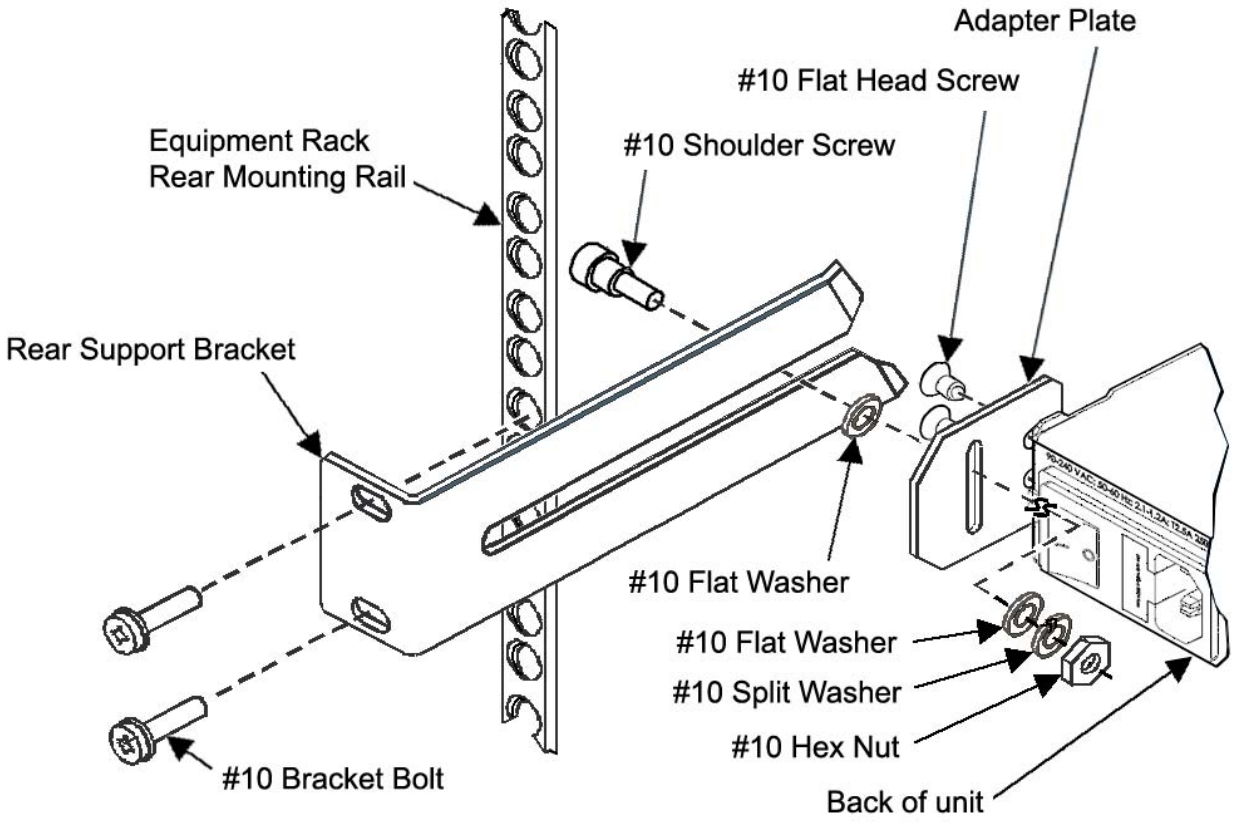


Figure 2-1. Installation of Optional Rear-Mounting Support Bracket Kit

Notes:

Chapter 3. REAR PANEL CONNECTOR PINOUTS

3.1 Connector Overview

The CDD-880 Multi Receiver Router rear panel connectors, shown here in **Figure 3-1**, provide all necessary external connections between the CDD-880 and other equipment. **Table 3-1** summarizes the connectors provided on the rear panel interface, grouped according to service function.

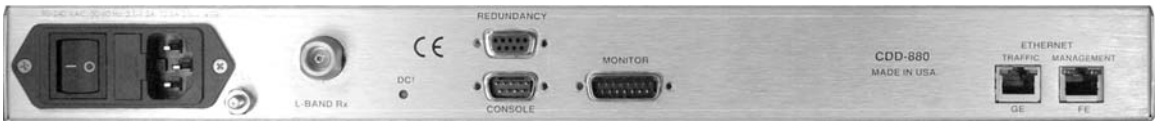


Figure 3-1. CDD-880 Rear Panel View

Table 3-1. Rear Panel External Connections

Connector Group	Name (Ref Des)	Connector Type	Function
IF Sect. 3.2	L-BAND Rx	Type 'N' female (L-Band)	IF Rx Input
Terrestrial Data Sect. 3.3	TRAFFIC GE	RJ-45 Female	10/100/1000 BaseT Gigabit Ethernet Traffic Interface
Utility Sect. 3.4	(FUTURE) REDUNDANCY	9-pin Type 'D' female	Connection to External 1:1 Controller (Redundancy Switch)
	CONSOLE	9-pin Type 'D' male	Serial Remote Interface (EIA-232)
	MONITOR	15-pin Type 'D' male	I&Q Constellation/Rx AGC Monitor Output
	MANAGEMENT FE	RJ-45 female	10/100 BaseT Fast Ethernet management and data
Power/Ground Sect 3.5	AC	See Sect. 3.5.1	Chassis power
	Ground	#10-32 stud	Common Chassis Ground

3.2 L-BAND Rx IF Connection, Type 'N'

The Rx IF input port connector is a 50Ω Type 'N' female. The return loss on these ports is typically better than 17 dB, and if the user wishes to connect to a 75Ω system, an inexpensive 'N' to 'F' type adapter can be used and is available as an optional accessory. While there will be a reduction in return loss when doing this, the effect in most systems will be imperceptible.

There may be DC voltages present on the Type 'N' Rx IF connector, up to a maximum of 48 volts. An LED labeled 'DC!' will light to indicate this condition.

3.3 TRAFFIC GE Terrestrial Data Connection, RJ-45F

The **TRAFFIC GE** connector is an RJ-45 female port used for 10/100/1000 Base-T Gigabit Ethernet data traffic. The connector pinout is as follows:

Pin #	Description	Direction
1	TRP1+	I/O
2	TRP1-	I/O
3	TRP2+	I/O
4	TRP3+	I/O
5	TRP3-	I/O
6	TRP2-	I/O
7	TRP4+	I/O
8	TRP4-	I/O

The port features two operational LED indicators:

- **LED 1 (to left) – Comms Link detected (glows amber)**
- **LED 2 (to right) – Activity Detected (flashes green)**

3.4 Utility Connections

3.4.1 (FUTURE) REDUNDANCY Connector, DB-9F

The **REDUNDANCY** connector provides the 1:1 control (redundant switch) interface via a 9-pin Type 'D' female (DB-9F) connector. It is intended for future connection to a CRS-500 M:N Redundancy System.

The connector provides serial communications to transfer configuration information from the Prime to the Backup router and a Fault/Clock signal to signal the switch when a fault occurs.

The connector pinouts are as follows:

Pin #	Name	Signal Function	Type
1	GND	Chassis Ground	Gnd
2	MDM_COM_IN	UART comm to modem from controller (9600 to115.2BUAD)	LVTTL Input
3	TX_IF_MUTE_B	Capability to mute modem's Tx IF (Low=Mute) (Use pull-up on Modem side input)	LVTTL Input
4	ONLINE	Commands modem to be Online/Offline (Use pull-up on Modem side input)	LVTTL Input
5	MDM_COM_OUT_ENA	Enable "Mdm_Comm_Out" signal	LVTTL Output
6	MDM_COM_OUT	UART comm. from modem to controller (9600 to115.2BUAD)	LVTTL Output
7	SER_CLK	Fault Serial Clock Signal 64KHz	LVTTL Output
8	SER_DATA	Fault Serial Data Signal from modem	LVTTL Output
9	12VOLT_OUT	+12 Volts at 300 ma	12V 300 ma

3.4.2 CONSOLE (Remote Control Interface) Connector, DB-9M

The **CONSOLE** connector provides the remote control interface via a 9-pin Type 'D' male (DB-9M) connector. The settings for this serial interface are always 38400/8-N-1. It is intended for connection to an M&C computer or terminal device for EIA-232.

The connector pinouts are as follows:

Pin #	Description	Direction
1	Ground	–
2	EIA-232 Transmit Data	Out
3	EIA-232 Receive Data	In
4	Reserved - do not connect to this pin	–
5	Ground	–
6	Reserved	–
7	Reserved	–
8	Reserved	–
9	Reserved	–

3.4.3 MONITOR Connector, DB-15M

The **MONITOR** connector provides the Rx constellation and analog AGC level of the selected demod via a 15-pin Type 'D' male (DB-15M) connector. The connector pinouts are as follows:

Pin #	Description	Direction
1	Ground	–
2	Reserved	–
3	Constellation Q channel	Out
4	Reserved	–
5	Reserved	–
6	Reserved	–
7	Reserved	–
8	Reserved	–
9	Reserved	–
10	Reserved	–
11	Constellation I channel	
12	Reserved	–
13	Rx AGC (0-3V)	
14	Reserved	–
15	Reserved	–

3.4.4 MANAGEMENT FE (M&C) Connector, RJ-45F

The **MANAGEMENT FE** 10/100 Ethernet connector is an 8-pin, RJ-45 female auto-sensing port, used for Ethernet-based remote management and control (M&C) of CDD-880 functions via Telnet/HTTP/SNMP. The connector pinouts are as follows:

Pin #	Description	Direction
1	TRP1+	I/O
2	TRP1-	I/O
3	TRP2+	I/O
4	TRP3+	I/O
5	TRP3-	I/O
6	TRP2-	I/O
7	TRP4+	I/O
8	TRP4-	I/O

The port features two operational LED indicators:

- **LED 1 (to left) – Comms Link detected (glows amber)**
- **LED 2 (to right) – Activity detected (flashes green)**

3.5 Power / Ground Connections

3.5.1 Alternating Current (AC) Power Connector (Standard)

IMPORTANT

For continued operator safety, always replace the fuses with the correct type and rating.

A standard, detachable, non-locking, 3-prong power cord (IEC plug) supplies the Alternating Current (AC) power to the CDD-880. The IEC line input connector contains the ON/OFF switch for the unit. It also is fitted with two fuses, one each for line and neutral connections (or L1, L2, where appropriate). These are contained within the body of the connector, behind a small plastic flap.

Observe the following:

AC Power Specifications	
Input Power	40W maximum, 20W typical
Input Voltage	100 - 240 volts AC, +6%/-10% - autosensing (total absolute max. range is 90 - 254 volts AC)
Connector Type	IEC
Fuse Protection	T3.15A Slow-blow (for 120/230 volt AC operation) Line and neutral fusing 20 mm type fuses

3.5.2 Ground Connector

A #10-32 stud is provided on the unit rear panel for connection of a common chassis ground among equipment.

Note: The AC power connector provides the safety ground.

Notes:

Chapter 4. FLASH UPGRADING

4.1 Flash Updating via Internet

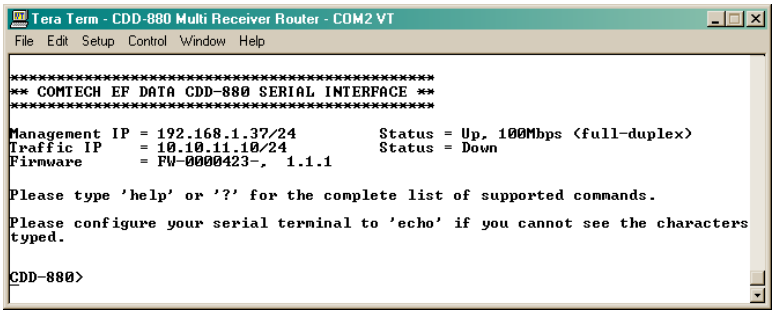
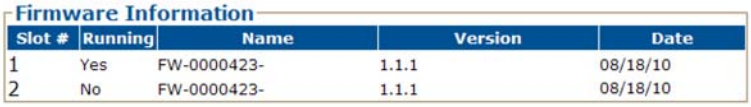
The CDD-880 Multi Receiver Router uses 'Flash memory' technology internally. This makes software upgrading very simple, and updates can now be sent over satellite, via the Internet (**Figure 4-1**), via E-mail, or on CD.

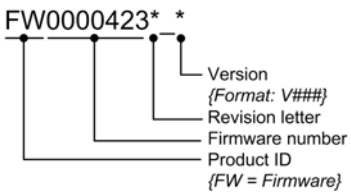
This chapter outlines the complete upgrading process as follows:

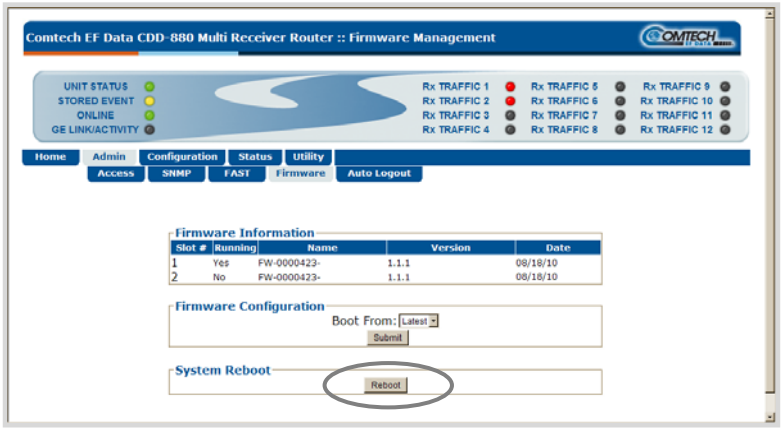
- New firmware can be downloaded via the Internet to an external PC.
- The upgrade can be performed without opening the unit over satellite or by simply connecting the unit to the Ethernet port of the external PC.
- The firmware update is transferred, via File Transfer Protocol (FTP), from the external PC to the unit.

Figure 4-1. Flash Update via Internet

4.2 Ethernet FTP Upload Procedure

Step	Procedure
1	**Identify the reflashable product, firmware number, and version for download.** a) Using a terminal emulator connected to the serial **CONSOLE** port, upon power-up of the unit a number of operational parameters, including the firmware number and version, are displayed on the Command Line Interface as per the following example:  b) Alternately, when using the Web Server Interface (via the **MANAGEMENT FE** 10/100 BaseT Fast Ethernet port), the Bootrom, Slot1 and Slot2 firmware loads may be obtained from viewing the '**Admin | Firmware**' page:  For detailed information about this page, see **Chapter 5, Section 5.4.4.3.4.**
2	**Create a temporary folder** (directory) on an external PC: • ***For Windows Explorer:*** Select **File > New > Folder** to create a new folder, then rename it from "**New Folder**" to "**temp**" or another convenient, unused name. Assuming "**temp**" works, a "***c:\temp***" folder should now be created. **Note:** The drive letter **c:** is used in this example. Any valid writable drive letter can be used. • ***For Windows Command-line:*** Click **[Start]** on the Windows taskbar, then click the "**Run...**" icon (or, depending on Windows OS versions *prior* to Windows 95, click the "**MS-DOS Prompt**" icon from the Main Menu). Then, to open a Command-line window… o ***For Windows 95 or Windows 98*** – Type "**command**". o ***For any Windows OS versions later than Windows 98*** – Type "**cmd**" *or* "**command**". ***Alternately,*** from **[Start],** select ***All Programs > Accessories > Command Prompt***. • At the Command-line prompt (c:\>), type "**mkdir temp**" or "**md temp**" (without quotes – **mkdir** and **md** stand for *make directory*). This is the same as creating a new folder from Windows Explorer. There should now be a "***c:\temp***" subdirectory created (where **c:** is the drive letter used in this example).

3	**Download the correct firmware file** to this temporary folder. As shown in **Figure 4-1**: a) Go online to: www.comtechefdata.com; b) Click on: ***Support*** tab; c) Click on: ***Software Downloads*** drop-down *or* hyperlink from ***Support*** page; d) Click on: ***Download Flash and Software Update Files*** icon; e) Click on: ***(Select a Product Line) Advanced VSAT Series*** hyperlink; f) Select the **CDD-880** product hyperlink; g) Select the appropriate firmware download hyperlink. **About Firmware Numbers, File Versions, and Formats:** Comtech EF Data's Web site catalogues its flashable firmware upgrade files by product type (e.g., modem, converter, etc.) and specific model/optional configuration. For the CDD-880, the firmware download hyperlink appears as **FW0000423X_V###** (where 'X' denotes the revision letter, and ### represents the firmware version).  The current version firmware release is provided. If applicable, one version prior to the current release is also available. Be sure to identify and download the desired version. The downloadable files are stored in two formats: ***.exe** (self-extracting) and ***.zip** (compressed). Some firewalls will not allow the downloading of *.exe files. In this case, download the *.zip file instead. For additional help with "zipped" file types, refer to *PKZIP for Windows*, *WinZip*, or *ZipCentral* help files. *PKZIP for DOS* is not supported due to file naming conventions.
4	**Extract the files** into the temporary folder on the PC. At least two files should be extracted: • **FW0000423x.bin**, where 'x' denotes the bulk image revision letter. • **CDD-880_ReleaseNotes_vXXX.pdf,** where 'XXX' denotes the firmware version.
5	**Confirm that the files have been extracted** to the specified temporary folder on the PC. Using Command-line, type "**cd c:\temp**" to change to the temporary directory created in **Step 2**, then use the "**dir**" command to list the files extracted from the downloaded archive file.
6	**Connect the external PC** to the MANAGEMENT FE 10/100 BaseT Ethernet port, via a hub or a switch, or directly to a PC with a crossover cable.
7	**Send a "ping" command** to the unit to verify the connection and communication: ***First*****,** determine the IP address of the unit remotely or by using the Web Server Interface: • **Remotely –** Use **<0/IPA?** command; the unit's configured IP address is returned, e.g., **`>0000/IPA=192.168.1.38/24`** • **Via Web Server Interface –** View the '**Configuration | Interface | FE Mgt**' page. *Then***, using Command-line to PING:** At the Command-line prompt, type "**ping *xxx.xxx.xxx.xxx***" (where '*xxx.xxx.xxx.xxx'* is the Management IP address of the unit). The results should confirm whether or not the modem is connected and communicating.
8	**Initiate an FTP session** with the unit (this example uses a Command-line window): a) From the PC, type "**ftp xxx.xxx.xxx.xxx**" where 'xxx.xxx.xxx.xxx' is the Management IP address of the CDD-880. b) Verify the FTP transfer is *binary* by typing "**bin**". c) Type "**prompt**" then type "**hash**" to facilitate the file transfers.

9	**Transfer the files:** Type "**put FW0000423x.bin**" (where 'x' denotes the revision letter) to begin the file transfers. It will take a few seconds to transfer the file. The process sequences through several blocks – this may take several minutes. When the upgrade image has been received, the image will be written to flash memory and the message "UPLOAD COMPLETE" will be displayed.
10	**Verify the file transfer.** a) **Terminate the FTP session** by typing "**bye"** and closing the Command-line window. b) **Verify** that the new file loaded using either the **CONSOLE** or **Web** interface as described in **Step 1**.
11	**Select the desired Slot (image) to boot:** Via the Web Server Interface's **Admin | Firmware** page, use the '**Boot From:**' drop-down menu to select **Latest**, **Slot 1**, or **Slot 2**, then click **[Submit]** to save the desired setting. By default, the unit will boot to the Slot that stores the firmware version having the *latest date* (**Boot From: Latest**). 
12	**Reboot the CDD-880.** *The firmware upgrade is implemented at this time.*
Flash Upgrading of the CDD-880 Multi Receiver Router is now complete.	

Chapter 5. ETHERNET MANAGEMENT

5.1 Introduction

The CDD-880 Multi Receiver Router is equipped with an RJ-45 10/100 BaseT Ethernet management interface, labeled **MANAGEMENT FE**, that is used for monitor and control purposes.

This chapter provides a high-level overview of the functionality provided by this interface. For details about using the CDD-880's serial remote interface, see **Appendix B. REMOTE CONTROL**.

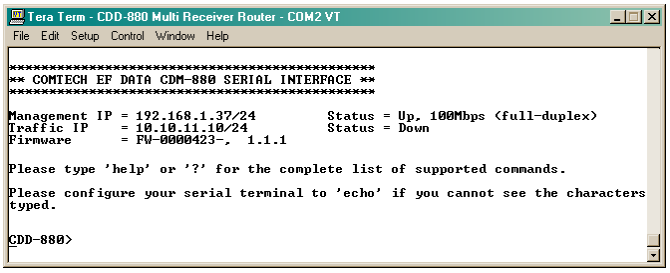
5.2 Ethernet Management Interface Protocols

The CDD-880's 10/100 BaseT Fast Ethernet (FE) Management Interface supports two management protocols:

- SNMP with public and private MIB
- Web Server (HTTP) Interface for complete product management

5.2.1 Ethernet Management Interface Access

Access to the CDD-880 Ethernet Management Interface requires the user to specify the unit's Management IP Address. This address may be obtained via use of a terminal emulator connected to the 9-pin serial **CONSOLE** port. As per the example shown to the right, a number of operational parameters (including the unit's default factory-assigned IP addresses) are displayed upon power-up of the unit.


Tera Term - CDD-880 Multi Receiver Router - COM2 VT
File Edit Setup Control Window Help
****
** COMTECH EF DATA CDM-880 SERIAL INTERFACE **
****
Management IP = 192.168.1.37/24 Status = Up, 100Mbps (full-duplex)
Traffic IP = 10.10.11.10/24 Status = Down
Firmware = FW-0000423-, 1.1.1
Please type 'help' or '?' for the complete list of supported commands.
Please configure your serial terminal to 'echo' if you cannot see the characters typed.
CDD-880>

The unit's default factory-assigned IP addresses are as follows:

Management IP Address	192.1.1.11
Traffic (GigE) IP Address	10.10.1.11

If otherwise assigned, the user may write down the IP Addresses for future reference:

UNIT MANAGEMENT IP ADDRESS: _____

UNIT TRAFFIC IP ADDRESS: _____

5.3 SNMP Interface

The *Simple Network Management Protocol* (SNMP) is an application-layer protocol designed to facilitate the exchange of management information between network devices. The CDD-880 SNMP agent supports both SNMPv1 and v2c.

For proper SNMP operation, the CDD-880 MIB files must be used with the associated version of the CDD-880 router M&C. Please refer to the CDD-880 FW Release Notes for information on the required FW/SW compatibility.

5.3.1 Management Information Base (MIB) Files

MIB files are used for SNMP remote management and consist of Object Identifiers (OIDs). Each OID is a node that provides remote management of a particular function. A MIB file is a tree of nodes that is unique to a particular device.

The following MIB files are associated with the CDD-880:

MIB File/Name	Description
FW10874-2-.mib ComtechEFData Root MIB file	ComtechEFData MIB file gives the root tree for ALL Comtech EF Data products and consists of only the following OID: Name: comtechEFData Type: MODULE-IDENTITY OID: 1.3.6.1.4.1.6247 Full path: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).comtechEFData(6247) Module: ComtechEFData
FW-0000423- .mib CDD-880 MIB file	MIB file consists of all of the OID's for management of the router functions

These MIB files should be compiled in a MIB Browser or SNMP Network Monitoring System server.

Note: The SNMP agent supports both **SNMPv1** and **SNMPv2c**.

5.3.2 SNMP Community Strings

The router uses community strings as a password scheme that provides authentication before gaining access to the router agent's MIBs.

In **SNMPv1** and **SNMPv2c**, the community string is sent unencrypted in the SNMP packets. Caution must be taken by the network administrator to ensure that SNMP packets travel only over a secure and private network if security is a concern. A packet sniffer can easily obtain the community string by viewing the SNMP traffic on the network.

The community string is typed into the MIB Browser or Network Node Management software and is used to authenticate users and determine access privileges to the SNMP agent.

The user defines two Community Strings for SNMP access:

- Read Community default = public
- Write Community default = private

5.4 Web Server (HTTP) Interface

The sections that follow describe the functionality of the CDD-880 Multi Receiver Router Web Server (HTTP) Interface.

5.4.1 Web Server Introduction

The embedded Web Server application provides the user with an easy to use interface to configure and monitor all aspects of the CDD-880. These Web pages have been designed for optimal performance when using Microsoft's Internet Explorer Version 7.0 or higher (the examples shown use Internet Explorer Version 7.0).

The user can fully control and monitor base operations of the CDD-880 from the Web Server Interface. By rolling the cursor over the navigation tabs located at the top of each page (right), the user can select from the available nested tabs.

5.4.2 User Login

To initiate a Web session with the CDD-880 Multi Receiver Router, from the PC type *http://www.xxx.yyy.zzzz* (where "*www.xxx.yyy.zzz*" represents the Management IP address of the CDD-880 Multi Receiver Router) into the **Address** area of the Web browser:

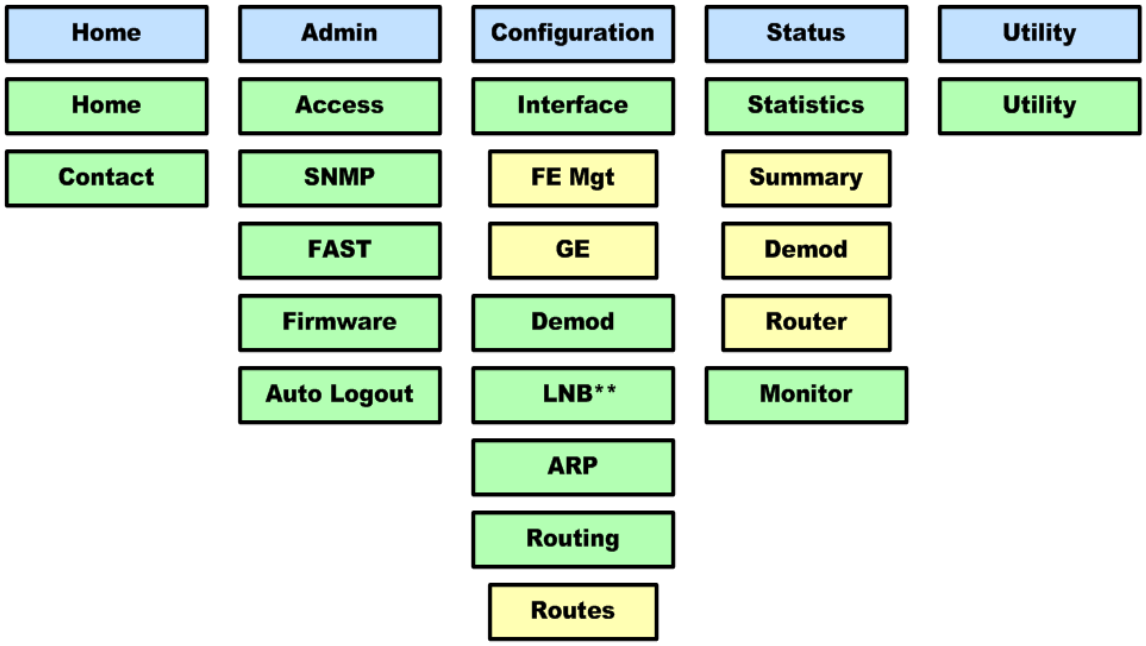
The user is then prompted to type in a valid **User Name** and **Password**, similar to the dialog box shown to the right. The default for both is **comtech**. Type the **User Name** and **Password**, then click **[OK]**.

Once the valid **User Name** and **Password** are accepted, the user will see the CDD-880 Multi Receiver Router Web Server Interface "splash" page, similar to the example shown to the right:

Comtech EF Data CDD-880 Multi Receiver Router :: Home
COMTECH EF DATA
CDD-880 Multi Receiver Router
Web Page Version 1.0.0
This web page interface is best viewed at 1280 x 1040 resolution
using IE 5.5 or higher on a 17" or larger monitor.

5.4.3 Web Server Menu Tree

The operations available through this interface are illustrated by this menu tree:



The CDD-880 Web Server Interface provides access to five (5) navigation tabs (shown in blue):

- **Home**
- **Admin**
- **Configuration**
- **Status**
- **Utility**

Beyond this top-level row of navigation tabs, the diagram illustrates the available primary (green) and nested (yellow) page tabs that afford the user more specific functionality.

IMPORTANT

The CDM-840 Web Server Interface pages in this diagram that are marked with double asterisks (**) are functional only when the specified items (e.g., LNBs) are installed.

Click any tab to continue.

5.4.4 Web Server Page Descriptions

IMPORTANT

Access to and availability of certain CDD-880 Web Server Interface pages are dependent upon the FAST options purchased for operation as well as the detected presence of auxiliary equipment (e.g., Low Noise Block Down Converter, Redundancy Switch, etc.) installed and configured for use with the CDD-880. Such operational restrictions will be noted in the subsections that follow through the end of this chapter.

5.4.4.1 About the Virtual Front Panel

Each page in the CDD-880 Web Server Interface features a 'Virtual Front Panel'. This *read-only* display emulates the operational state of the CDD-880 front panel LEDs, affording the user with true 'heads-up' operational status indicators that react dynamically to the configuration changes made via the Web Server Interface pages.

5.4.4.2 Home Pages

Click the **Home** or **Contact** tab to continue.

5.4.4.2.1 Home | Home

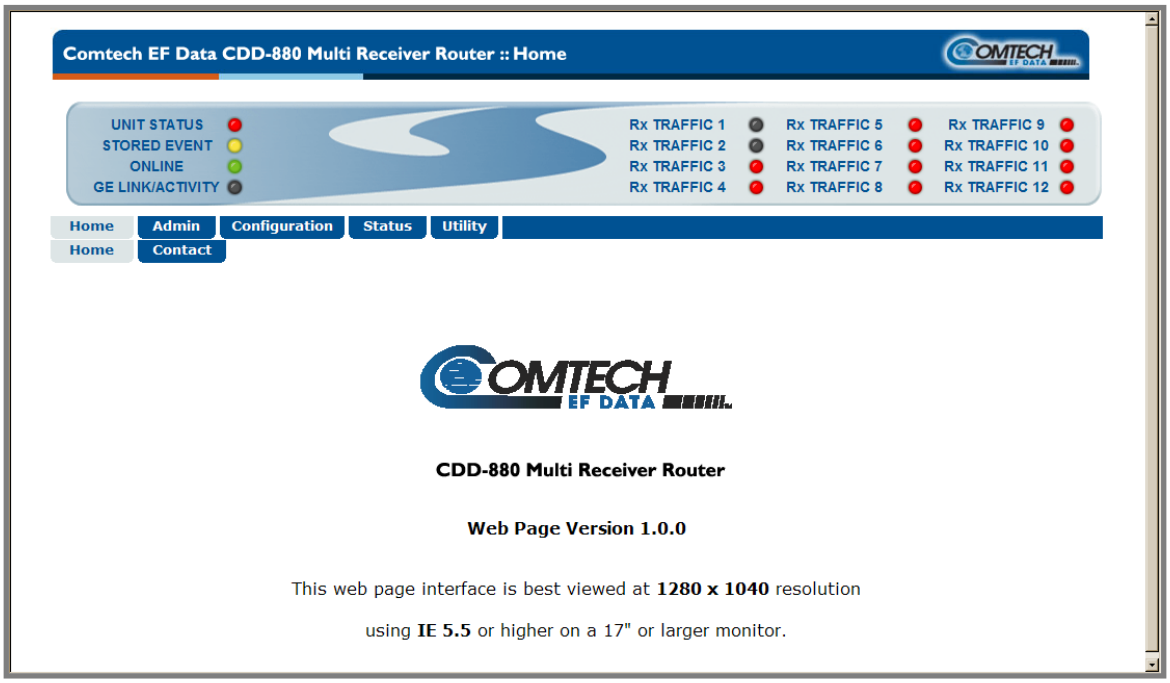


Figure 5-1. CDD-880 Multi Receiver Router Home (Splash) page

From any location within the Web Server Interface, the user can click the **Home** top navigation tab and/or the nested tab to return back to this top-level "splash" page.

5.4.4.2.2 Home | Contact

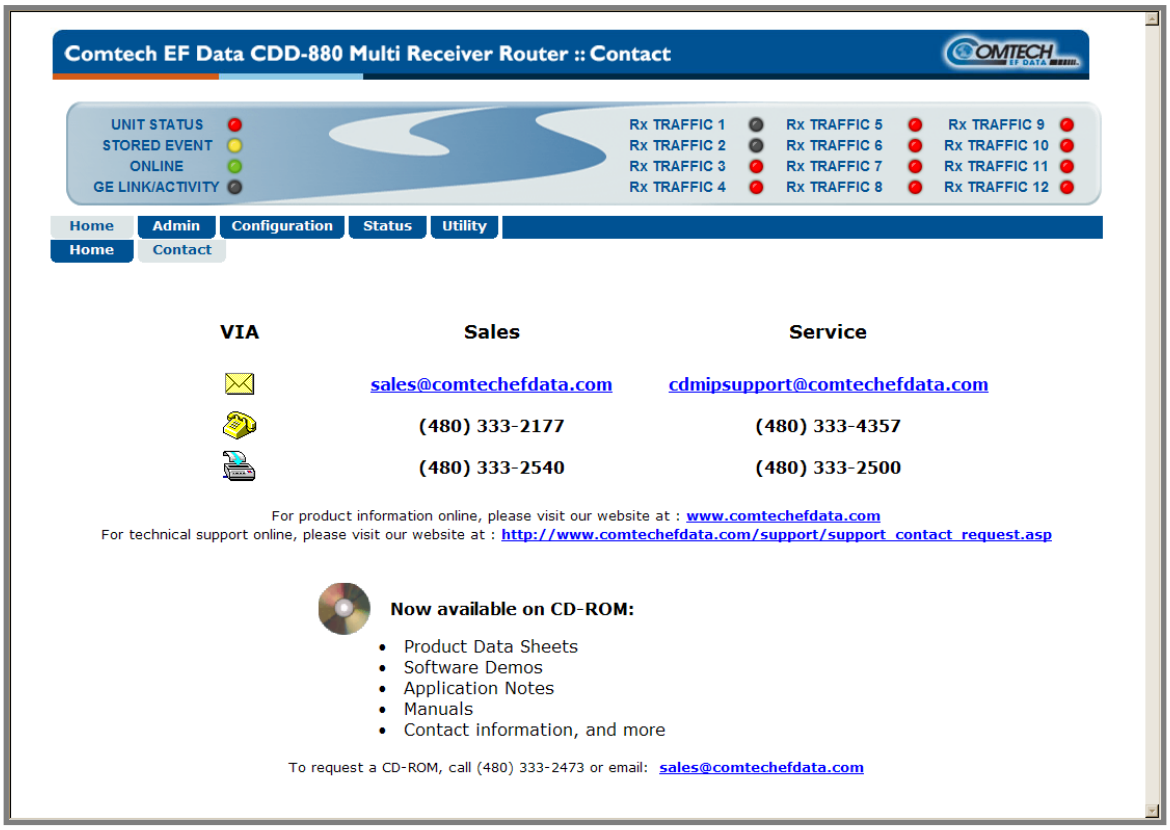


Figure 5-2. Home | Contact page

The '**Home** | **Contact**' page (**Figure 5-2**) provides basic contact information to reach Comtech EF Data Sales and Customer Support via phone, fax, or Web/e-mail hyperlinks.

5.4.4.3 Admin Pages

The '**Admin'** pages (**Figure 5-3** through **Figure 5-7**) provide the means to set up the access parameters required to facilitate communication with the CDD-880 Web Server Interface.

IMPORTANT

The Admin pages are available only to users who have logged in using the Administrator Name and Password.

Click the **Access**, **SNMP**, **FAST**, **Firmware**, or **Auto Logout** tab to continue.

5.4.4.3.1 Admin | Access

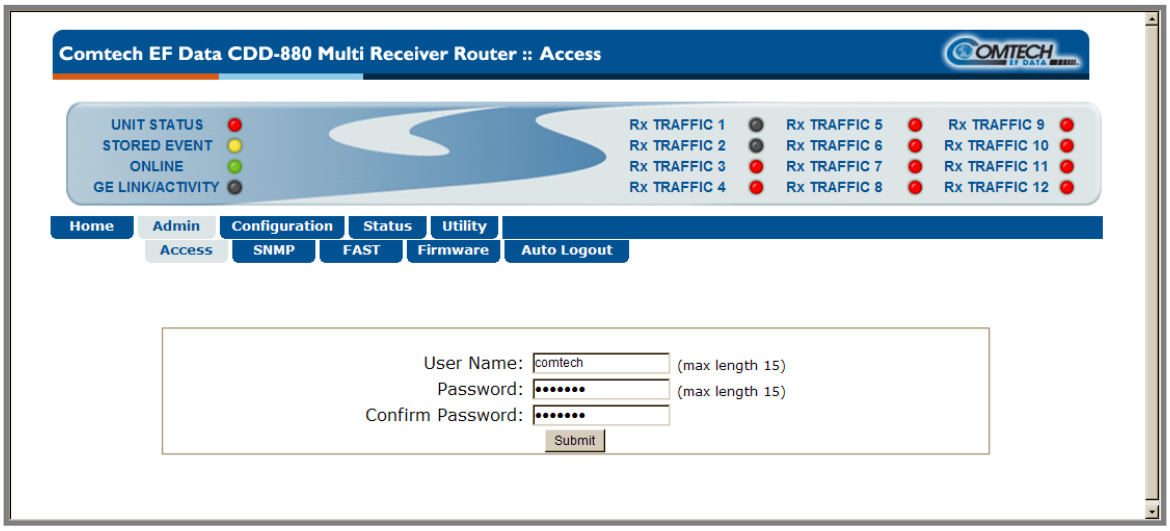


Figure 5-3. Admin | Access page

The '**Admin | Access'** page (**Figure 5-3)** provides the means to set up the user names and passwords that facilitate access to the CDD-880 Web Server Interface.

User

The factory default for both the User Name and Password is **comtech**. Note the following:

- The **User Name** can be any alphanumeric combination with a maximum length of 15 characters.
- The **Password** can be any alphanumeric combination with a maximum length of 15 characters. Once created, re-enter that Password in the **Confirm Password** text box.

Click **[Submit]** as needed to save the desired User Name and Password that have been created using this page.

5.4.4.3.2 Admin | SNMP

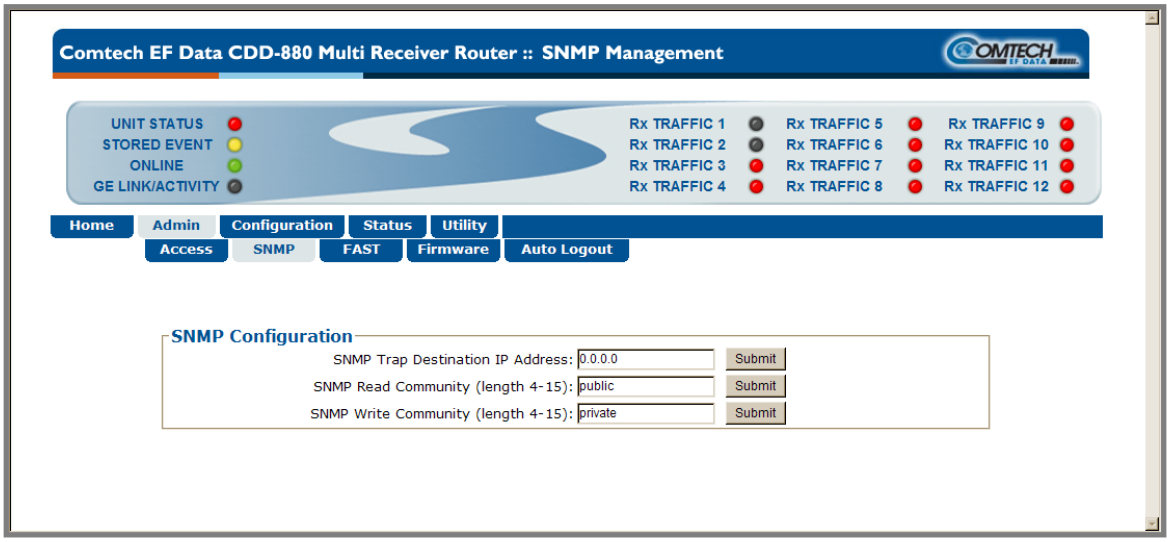


Figure 5-4. Admin | SNMP page

The '**Admin | SNMP'** page (**Figure 5-4**) sets and returns administration information for the CDD-880 Simple Network Management Protocol (SNMP) feature. For further information about SNMP, see **Section 5.3 SNMP INTERFACE**.

SNMP Configuration

Use the provided text boxes to assign the desired SNMP configuration string. For each string created, click [**Submit]** as needed to save the change(s). Note the following:

- **(FUTURE)** A single **SNMP Trap Destination IP Address** can be assigned.
- An **SNMP Read Community String** can be assigned. This string can be any combination of characters and a length of 4 - 15 characters. The factory default for this parameter is **public**.
- An **SNMP Write Community String**. This string can be any combination of characters and a length of 4 - 15 characters. The factory default for this parameter is **private**.

5.4.4.3.3 Admin | FAST

IMPORTANT

Upgrading the FAST features will cause the unit to reboot with reconfiguration of all appropriate operating parameters.

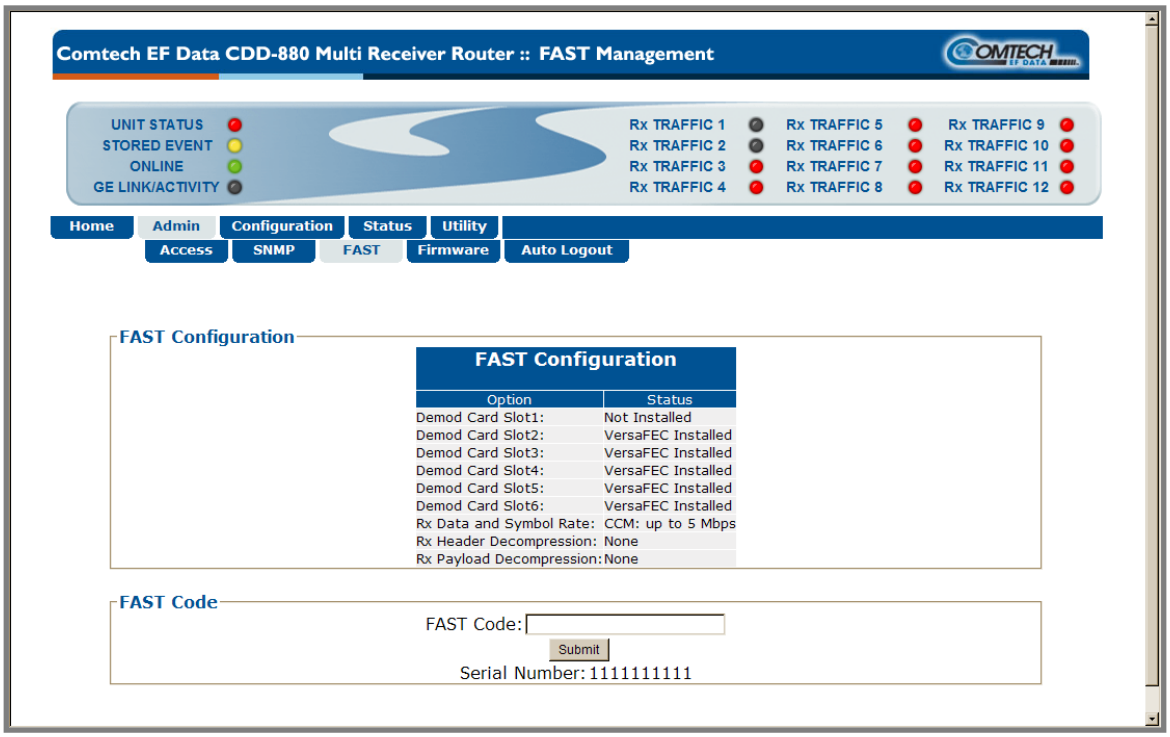


Figure 5-5. Admin | FAST page

The CDD-880 incorporates a number of optional features that may be activated by the user after purchase via **F**ully **A**ccessible **S**ystem **T**opology (**FAST**) codes, which are special authorization codes obtained from Comtech EF Data loaded into the unit via the '**Admin | FAST**' page (**Figure 5-5**). These unique access codes may be purchased during normal business hours from Comtech EF Data.

FAST Configuration

This *read-only* section displays the CDD-880's available FAST Features and the operational status for each available option. Each available feature is listed in the **Option** column. When an option is enabled, the **Status** column identifies the option as such along with its operational parameter(s); if an option is not enabled, the column will display this information accordingly.

FAST Access

The serial number of the unit, required by Comtech EF Data when ordering FAST option upgrades, is provided here for user reference. Once a 20-digit FAST authorization code is obtained from Comtech EF Data, enter this code ***carefully*** into the **FAST Code** text box, then click **[Submit]**. The unit will either accept or reject the code, and the **FAST Configuration** section will refresh to reflect any upgrades in operation.

5.4.4.3.4 Admin | Firmware

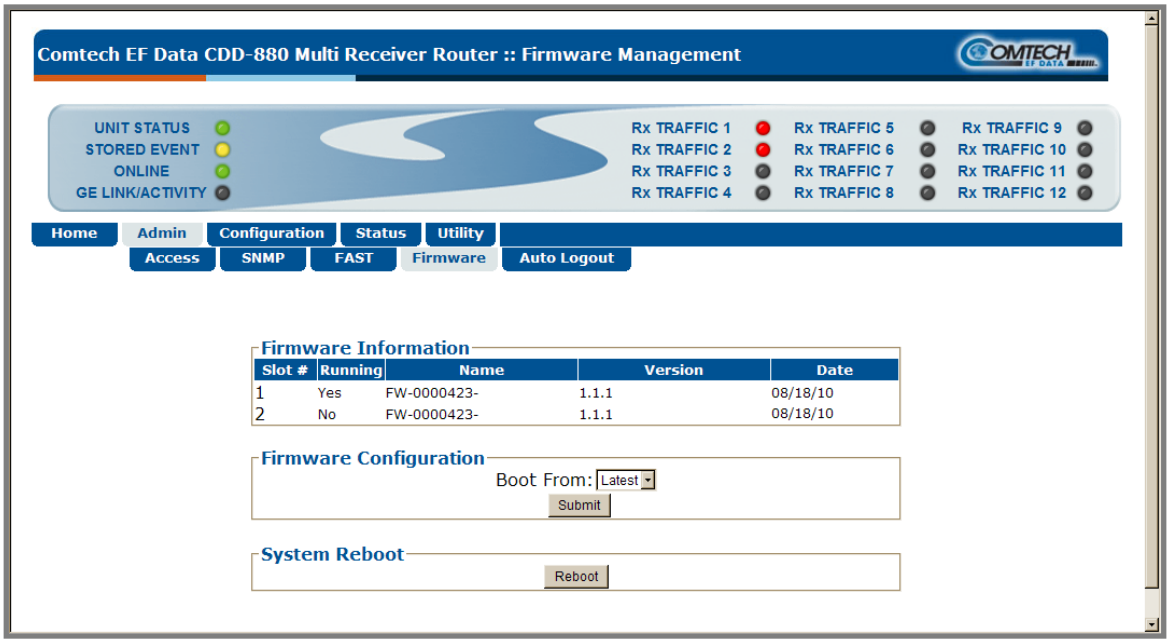


Figure 5-6. Admin | Firmware page

The '**Admin | Firmware'** page (**Figure 5-6**) is used to select the *current active firmware image* to be loaded for operation upon power-up or soft reboot.

Slot Information

This ***read-only*** status section provides information about the firmware loaded into boot Slot 1 or Slot 2.

Firmware Configuration

Using the **Boot From:** drop-down menu, select **Latest, Slot 1, or Slot 2**, then click **[Submit]** when done. The default selection is **Latest** where, the unit will automatically select the image that contains the most current firmware.

In this example, **Slot 1** is selected to become the active loaded Bootrom – the user must reboot the unit in order for this change to take effect. Note that the Firmware Information section, which displays Slot 2 as the designated *current active firmware image*, will *not* update until *after* the unit is rebooted.

5.4.4.3.5 Admin | Auto Logout

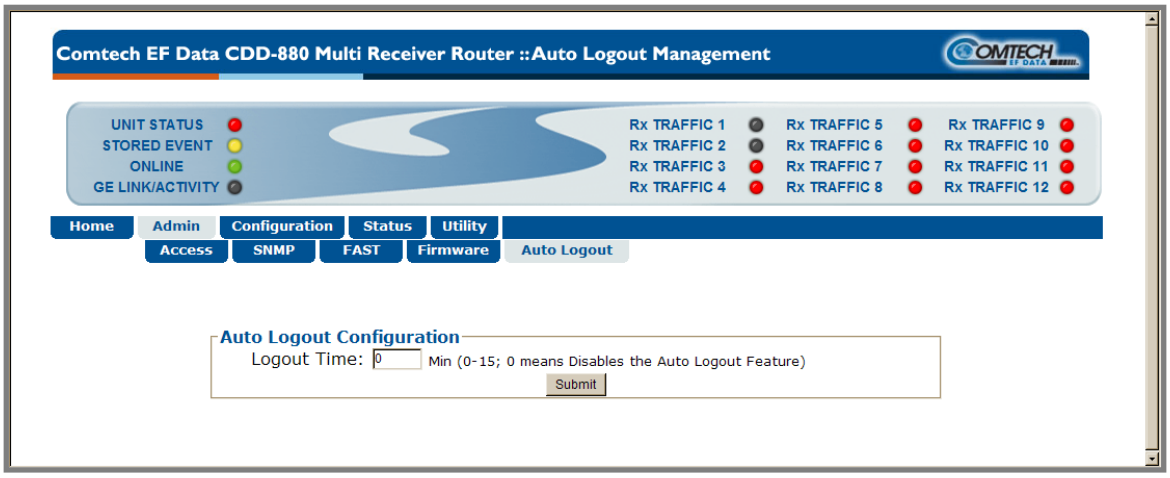


Figure 5-7. Admin | Auto Logout page

The '**Admin | Auto Logout'** page (**Figure 5-7**) provides a security measure for safeguarding access to a previously logged-in unit.

Once configured, the active session will be terminated if the unit is allowed to remain idle (i.e., when no user activity occurs) for the specified Auto Logout timeframe. A valid user name and password will then be required to open a new session with the CDD-880 Web Server Interface.

Auto Logout Configuration

To configure the Auto Logout feature, enter a value of 1 – 15 minutes into the **Logout Time** box. Entering a value of **0** *disables* the Auto Logout feature. Once the desired setting has been entered, click **[Submit]** to save this change.

5.4.4.4 Configuration Pages

The '**Configuration**' pages are used to configure all router parameters. Click the **Interface**, **Demod**, **ARP**, or **Routing** tab to continue (the '**Configuration | LNB**' page is inoperable at this time).

5.4.4.4.1 Configuration | Interface

Click the **FE Mgt** or **GE** tab to continue.

5.4.4.4.1.1 Configuration | Interface | FE Mgt

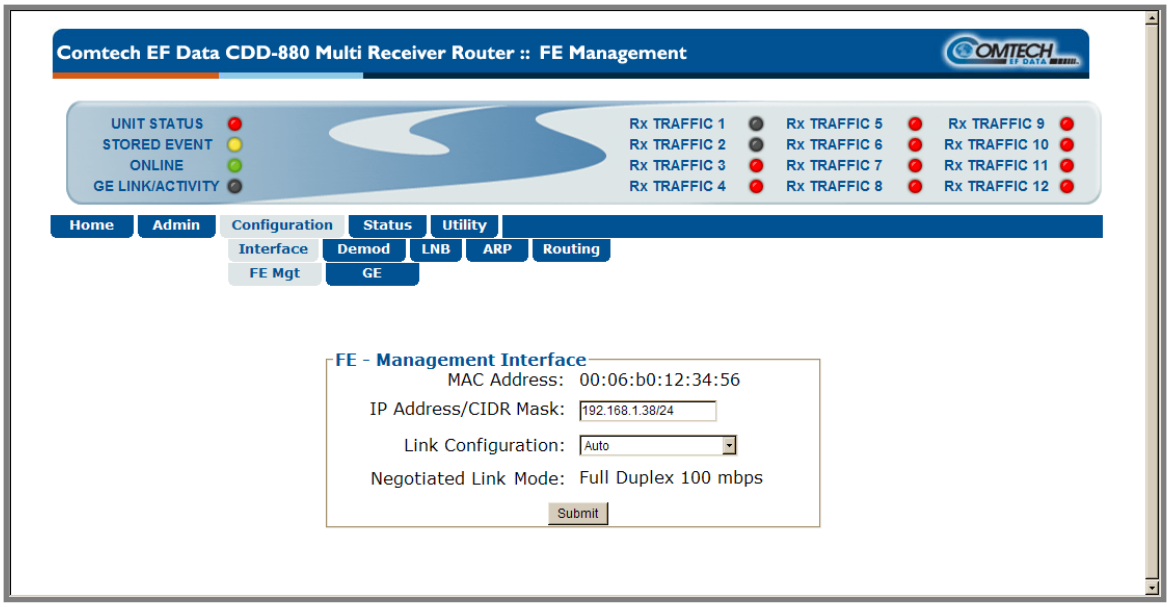


Figure 5-8. Configuration | Interface | FE Mgt page

The '**Configuration | Interface | FE Mgt'** page (**Figure 5-8**) permits the user to configure the 10/100 BaseT Fast Ethernet (FE) Management (M&C) port.

FE – Management Interface

MAC Address – This parameter is ***read-only*** and cannot be changed.

IP Address / CIDR Mask – Enter the IP Address and CIDR (Classless Inter-Domain Routing) Subnet Mask using this box (the Subnet Mask valid range is from 8 – 30).

Link Configuration – Use the drop-down menu to select the line speed and duplex setting for the CDD-880's FE interface. The available options are:

- Auto
- 1000 BaseT / Full Duplex (GigE only)
- 100 BaseT / Full Duplex
- 100 BaseT / Half Duplex
- 10 BaseT / Full Duplex
- 10 BaseT / Half Duplex

Note: If the configuration of the port is unknown, then "Auto" is the recommended configuration.

Negotiated Link Mode – The ***read-only*** actual negotiated line speed and duplex setting for the FE interface is displayed here. The viewable settings are:

- 1000 BaseT / Full Duplex
- 100 BaseT / Full Duplex (GigE only)
- 100 BaseT / Half Duplex
- 10 BaseT / Full Duplex
- 10 BaseT / Half Duplex

Once the desired configuration settings have been made on this page, click **[Submit]** as needed to save these changes.

5.4.4.4.1.2 Configuration | Interface | GE

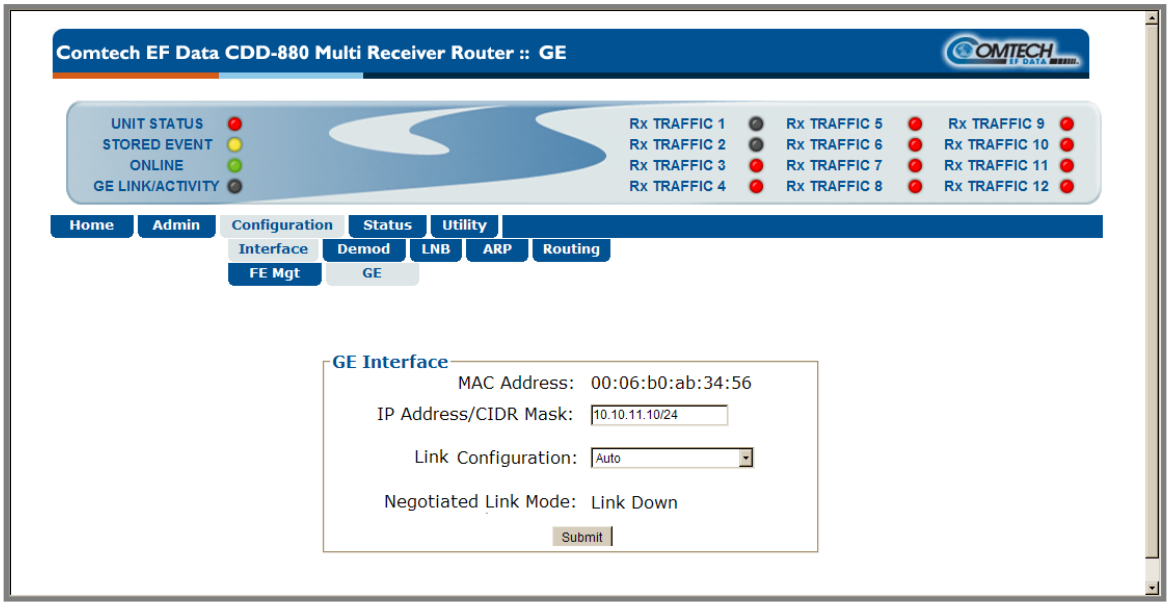


Figure 5-9. Configuration | Interface | GE page

The '**Configuration | Interface | GE'** and '**GE-2**' page (**Figure 5-9**) permits the user to configure the GE (10/100/1000 BaseT Gigabit Ethernet) port.

GE Interface

The configuration options available for both pages are identical to those provided on the '**Configuration | Interface | FE Mgt**' page. Refer back to **Section 5.5.4.4.1.1** for information about using the features of this page.

Note: As a router, the FE and GigE must be on difference subnets.

5.4.4.4.2 Configuration | Demod

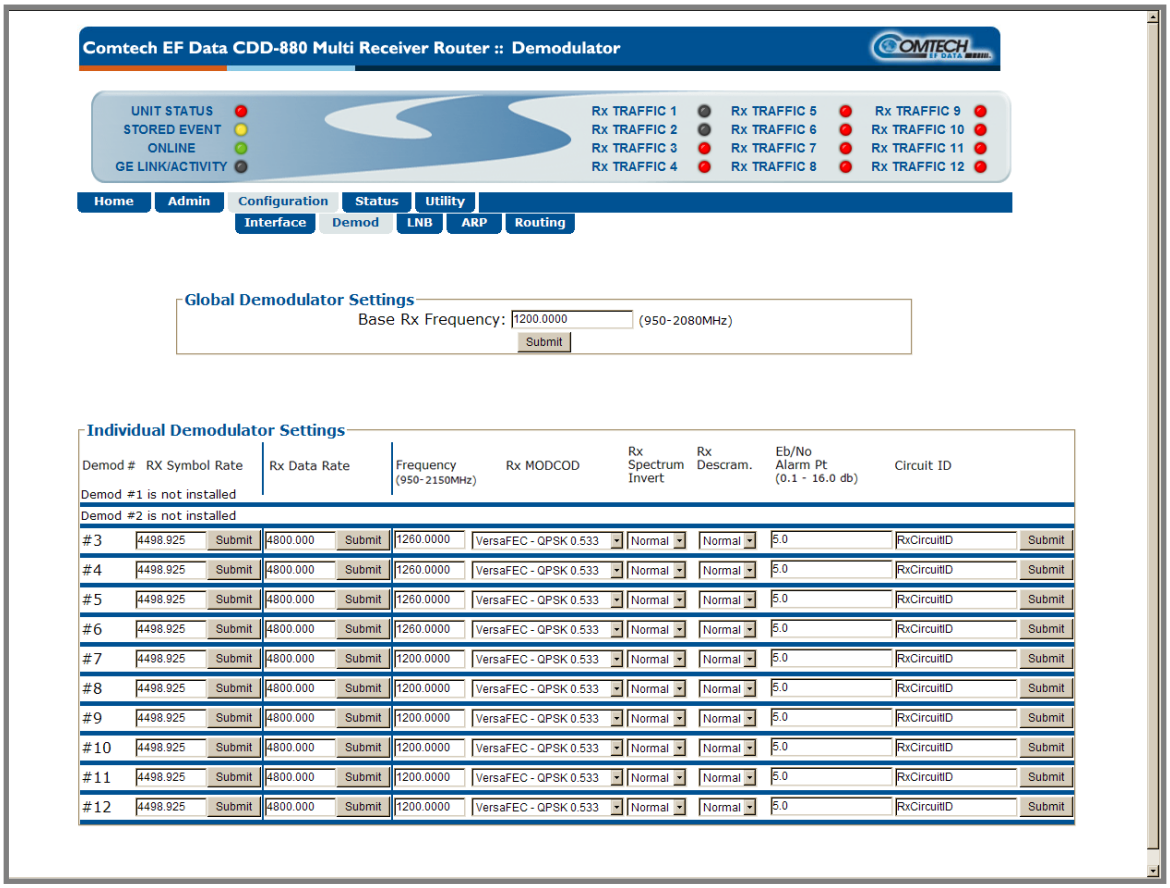

Comtech EF Data CDD-880 Multi Receiver Router :: Demodulator
UNIT STATUS
STORED EVENT
ONLINE
GE LINK/ACTIVITY
Rx TRAFFIC 1
Rx TRAFFIC 2
Rx TRAFFIC 3
Rx TRAFFIC 4
Rx TRAFFIC 5
Rx TRAFFIC 6
Rx TRAFFIC 7
Rx TRAFFIC 8
Rx TRAFFIC 9
Rx TRAFFIC 10
Rx TRAFFIC 11
Rx TRAFFIC 12
Home
Admin
Configuration
Status
Utility
Interface
Demod
LNB
ARP
Routing
Global Demodulator Settings
Base Rx Frequency: 1200.0000 (950-2080MHz)
Submit
Individual Demodulator Settings
Demod # RX Symbol Rate
Rx Data Rate
Frequency (950-2150MHz)
Rx MODCOD
Rx Spectrum Invert
Rx Descram.
Eb/No Alarm Pt (0.1 - 16.0 db)
Circuit ID
Demod #1 is not installed
Demod #2 is not installed
#3 4498.925 Submit 4800.000 Submit 1260.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#4 4498.925 Submit 4800.000 Submit 1260.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#5 4498.925 Submit 4800.000 Submit 1260.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#6 4498.925 Submit 4800.000 Submit 1260.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#7 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#8 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#9 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#10 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#11 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit
#12 4498.925 Submit 4800.000 Submit 1200.0000 VersaFEC - QPSK 0.533 Normal Normal 5.0 RxCircuitID Submit

Figure 5-10. Configuration| Mod page

The '**Configuration | Demod'** page (**Figure 5-10**) permits the user to configure CDD-880 Tx modulator operations. Note that, for any configuration item requiring text entry, a reference to the operational ranges for that text box is provided to the right of that text box.

Global Demodulator Settings

Base Rx Frequency – The Base Rx Frequency defines the 70 MHz range for which all demods must be configured.

Enter the router's Base Rx Frequency, in MHz. The valid ranges are from 950 to 2080 MHz. Once the desired Base Rx Frequency has been set, click **[Submit]** as needed to save this change.

Individual Demodulator Settings

The Web Server Interface polls current operations and populates this section with the configured Demodulators (i.e., **Demod #1** through **Demod #12**). If a slot is polled as empty or otherwise unrecognizable, a message is displayed – e.g., **Demod #X is not installed** – in place of a configurable row of parameters. For each operating demodulator, note the following:

Rx Symbol Rate – Enter the symbol rate, in ksps. The valid range is from 16 ksps. – 4.5 Mbps.

Rx Data Rate – Enter the data rate, in kbps. The valid range is from 16 kbps – 15.350 Mbps.

Frequency – Enter the Rx frequency, in MHz. The valid range is from 950 – 2150 MHz.

Rx MODCOD – Use the drop-down menu to select the Demodulation type and FEC rate (**MODCOD)**. Selections are as follows:

- VersaFEC – QPSK 0.488
- VersaFEC – QPSK 0.533
- VersaFEC – QPSK 0.631
- VersaFEC – QPSK 0.706
- VersaFEC – QPSK 0.803
- VersaFEC – 8-QAM 0.642
- VersaFEC – 8-QAM 0.711
- VersaFEC – 8-QAM 0.780
- VersaFEC – 16-QAM 0.731
- VersaFEC – 16-QAM 0.780
- VersaFEC – 16-QAM 0.829
- VersaFEC – 16-QAM 0.853

Rx Spectrum Invert – Use the drop-down menu to select Spectrum Inversion operation as either **Normal** or **Inverted**.

Rx Descram – Use the drop-down menu to select Rx Descrambling as either **Off** or **Normal**.

Eb/No Alarm Pt – The value referred to here, as calculated by the demodulator, is the energy per bit (Eb), divided by the noise spectral density (No). Enter the Eb/No Alarm Point value, in dB. The valid range is from 0.1 – 16.0.

Circuit ID –Enter a Circuit ID string consisting of 4 to 24 characters. Once the desired string had been entered in this section, click **[Submit]** as needed to save this change.

5.4.4.4.3 Configuration | LNB (Low Noise Block Down Converter) (FUTURE)

Operation of the CDD-880 with a Low Noise Block Down Converter is reserved as a future operational feature. While the Configuration | LNB tab is selectable, and the page is viewable, it is inoperable at present.

5.4.4.4.4 Configuration | ARP

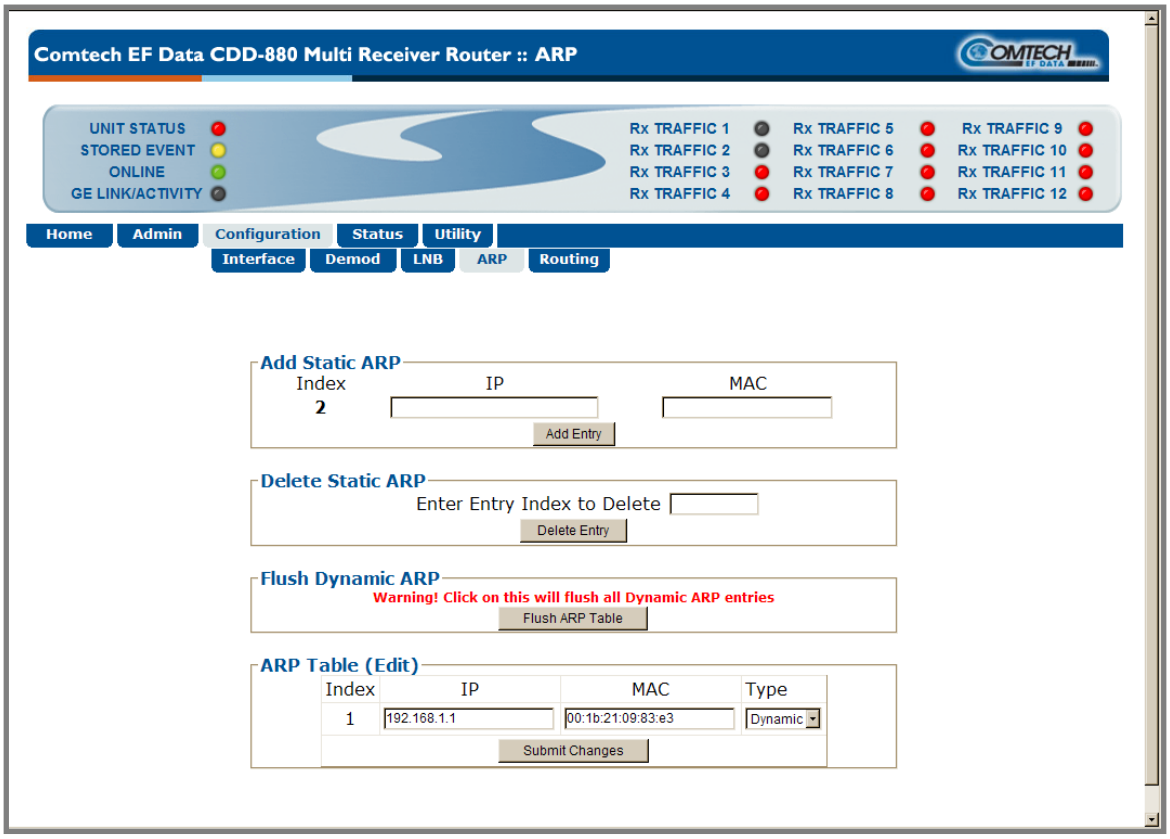


Figure 5-11. Configuration | ARP page

The '**Configuration | ARP**' page (**Figure 5-12**) is used to configure the router's ARP (Address Resolution Protocol) parameters.

Add Static ARP

This section allows the user to directly add a static ARP entry. Note that the index will automatically increment to the next available number.

Click **[Add Entry]** once all changes have been made in this section.

Delete Static ARP

Enter Entry Index to Delete, then click **[Delete Entry]** once this information has been entered in this section.

Flush Dynamic ARPs

Click **[Flush ARP Table]** to delete all dynamically learned ARP entries.

ARP Table (Edit)

This section displays all current Static and Dynamic ARP entries, and allows to user to directly edit the current Static ARP entries. Note the following:

Index (read-only) – This is the internal table index and it cannot be edited;

IP – Entry IP Address, format XXX.XXX.XXX.XXX;

MAC – Entry MAC Address, format YY:YY:YY:YY:YY;

Type (read-only) – Entry Type is identifiable as **Static** or **Dynamic** and cannot be edited.

Click **[Submit Changes]** once the desired edits have been made in this section.

5.4.4.4.5 Configuration | Routing

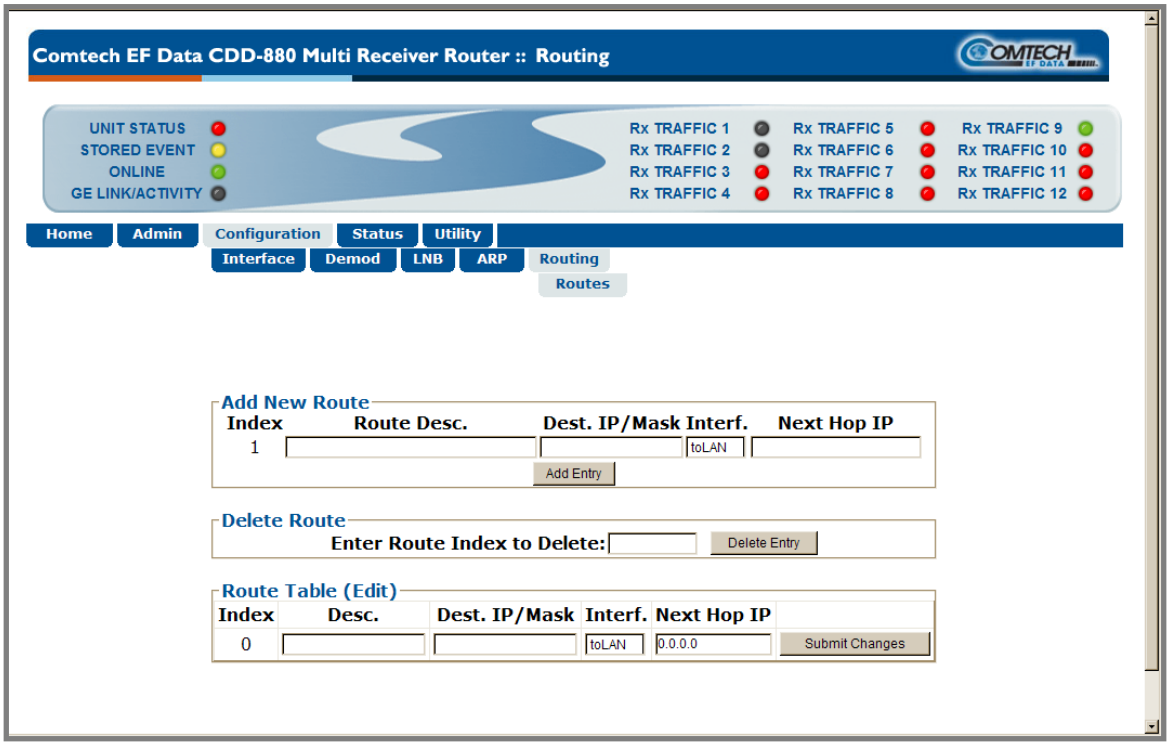


Figure 5-12. Configuration | Routing (Routes) page

By using the '**Configuration | Routing (Routes)**' page (**Figure 5-13**) static routes can be entered to route IP traffic to another device on the local LAN.

Add New Route

This section allows the user to directly add a route entry using text boxes and drop-down menus as described below for the **Route Table (Edit**) section.

Click **[Add Entry]** once all settings have been created in this section. Note that, when a new route is added, the index automatically increments to the next available number.

Delete Route

Enter Route Index to Delete, then click **[Delete Entry]** once all changes have been made to this section. The specified route entry will then be deleted from the route table.

Route Table (Edit)

This section displays and allows the user to edit all current Route Table entries. Note the following:

Index – This is the internal table index that is automatically assigned and cannot be edited.

Desc. – Enter a string label in this text box. Provided to help users maintain their network, the assigned name cannot contain any whitespace and must be unique.

Dest. IP/Mask – Enter a Destination IP Address/Mask in the form XXX.XXX.XXX.XXX/YY.

Interf – This section defaults only to **toLAN**.

Next Hop IP – Enter the desired Next Hop IP Address for **toLAN** routes.

Click **[Submit Changes]** once all changes have been made to this section.

5.4.4.5 Status pages

The **Status** pages (through) provide the user with status, event logging, and operational statistics windows. Click the **Statistics** or **Monitor** tab to continue.

5.4.4.5.1 Status | Statistics pages

Click the **Summary**, **Demod**, or **Router** tab to continue.

5.4.4.5.1.1 Status | Statistics | Summary

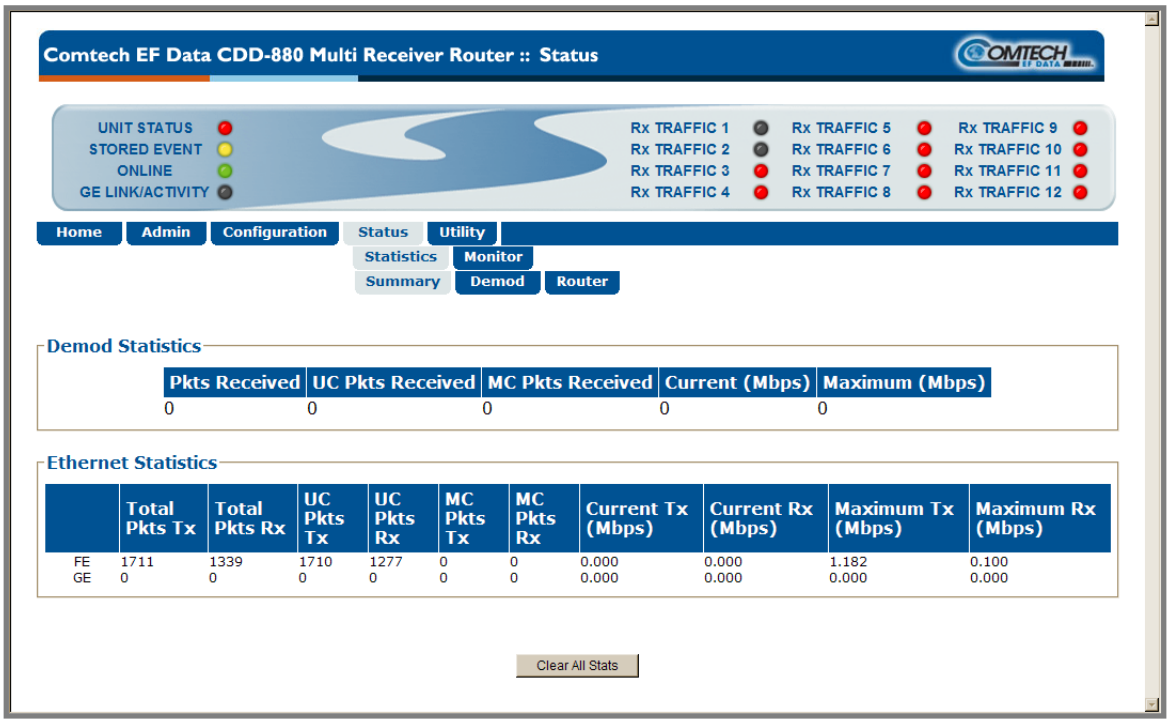


Figure 5-13. Status | Statistics | Summary page

The '**Status | Statistics | Summary'** page (**Figure 5-14**) provides the user with ***read-only,*** abridged status windows pertaining to the basic operational statistics for the Demodulator or Ethernet traffic.

Demod Statistics

Note that, while the demodulator traffic information on the '**Status | Statistics | Demod'** page is tallied on a *per-demod* basis, the information on this page is tallied on a *cumulative* (unit) basis. For each unit, note the following:

Pkts Received – Packets received.

UC Pkts Received – Unicast packets received.

MC Pkts Received – Multicast packets received.

Current (Mbps) – Most recent symbol rate (in megabits per second).

Maximum (Mbps) – Peak symbol rate (in megabits per second).

Ethernet Statistics

Total Pkts Tx – Total number of packets transmitted.

Total Pkts Rx – Total number of packets received.

UC Pkts Tx – Unicast packets transmitted.

UC Pkts Rx – Unicast packets received.

MC Pkts Tx – Multicast packets transmitted.

MC Pkts Rx – Multicast packets received.

Current Tx (Mbps) – Most recent transmitted data rate (in megabits per second).

Current Rx (Mbps) – Most recently received data rate (in megabits per second).

Maximum Tx (Mbps) – Peak transmitted data rate (in megabits per second).

Maximum Rx (Mbps) – Peak received data rate (in megabits per second).

Click **[Clear All Stats]** to delete all existing entries from the Summary Statistics page.

5.4.4.5.1.2 Status | Statistics | Demod

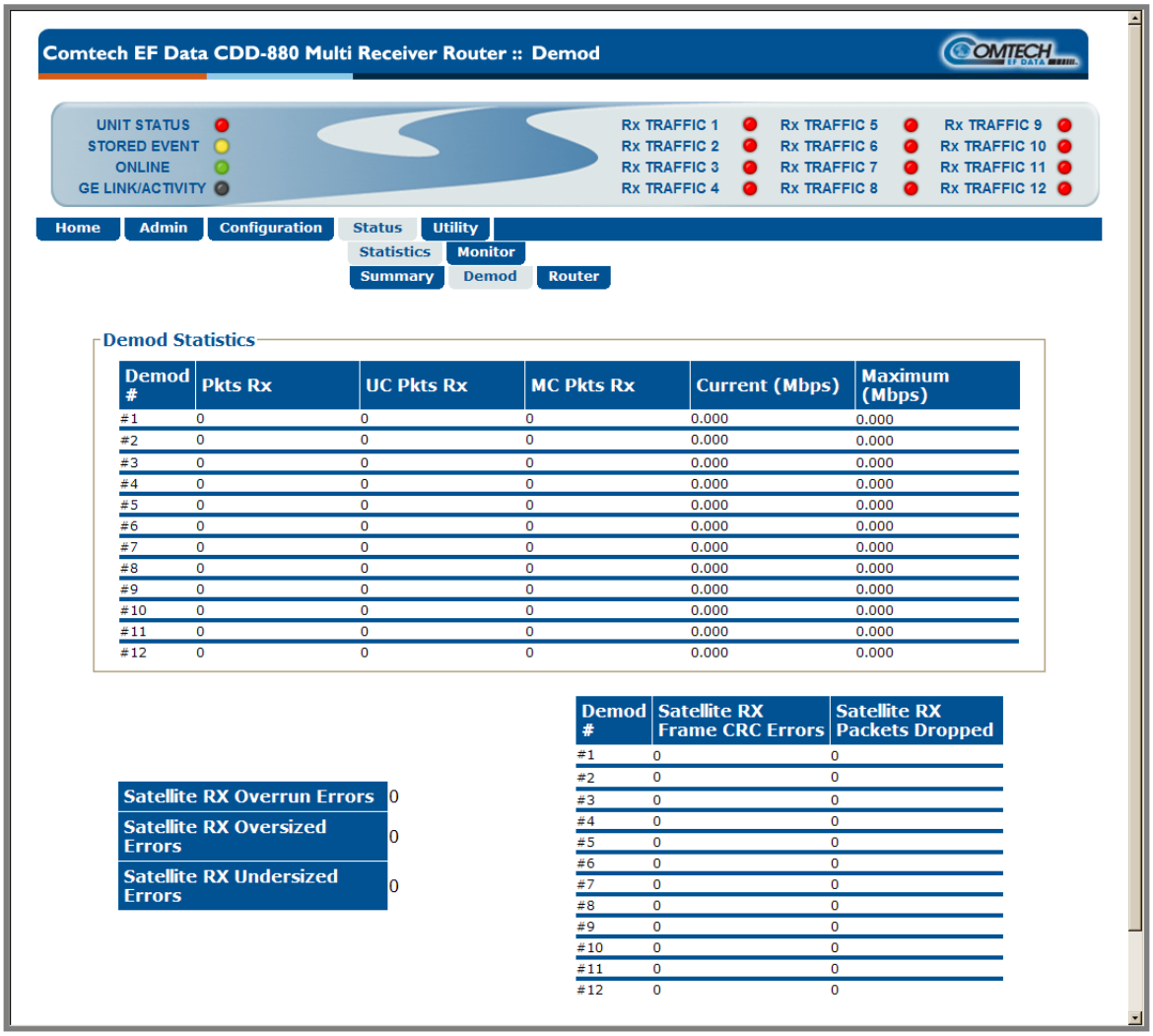


Figure 5-14. Status | Statistics | Demod page

The '**Status | Statistics | Demod'** page (**Figure 5-15)** is used to view cumulative demodulator traffic information.

The Web Server Interface polls current operations and populates this section with the configured demodulators (i.e., **Demod #1** through **Demod #12**). If a slot is polled as empty or otherwise unrecognizable, a message is displayed – e.g., **Demod #X is not installed** – in place of a configurable row of parameters.

Demod Statistics

Note that, whereas the information provided on the '**Status | Statistics | Summary**' page is tallied on a *cumulative* (unit) basis, the information on this page is tallied on a *per-demod* basis.

For each operating demodulator, note the following:

Pkts Rx – Packets received.

UC Pkts Rx – Unicast packets received.

MC Pkts Rx – Multicast packets received.

Current (Mbps) – Most recent symbol rate (in megabits per second).

Maximum (Mbps) – Peak symbol rate (in megabits per second).

(Satellite Rx Statistics)

Satellite RX Overrun Errors – Packets dropped after being combined from all 12 demods (aggregate data rate too high).

Satellite RX Oversized Errors – Packets dropped because size is greater than 2047 bytes.

Satellite RX Undersized Errors – Packets dropped because size is smaller than WAN frame (usually due to channel noise).

On a per-demod (i.e., Demod #1 through Demod #12) basis:

Satellite RX Frame CRC Errors – Streamline decoder CRC error – packet discarded.

Satellite RX Packets Dropped – Packets dropped before being combined into aggregate path (aggregate data rate too high).

5.4.4.5.1.3 Status | Statistics | Router

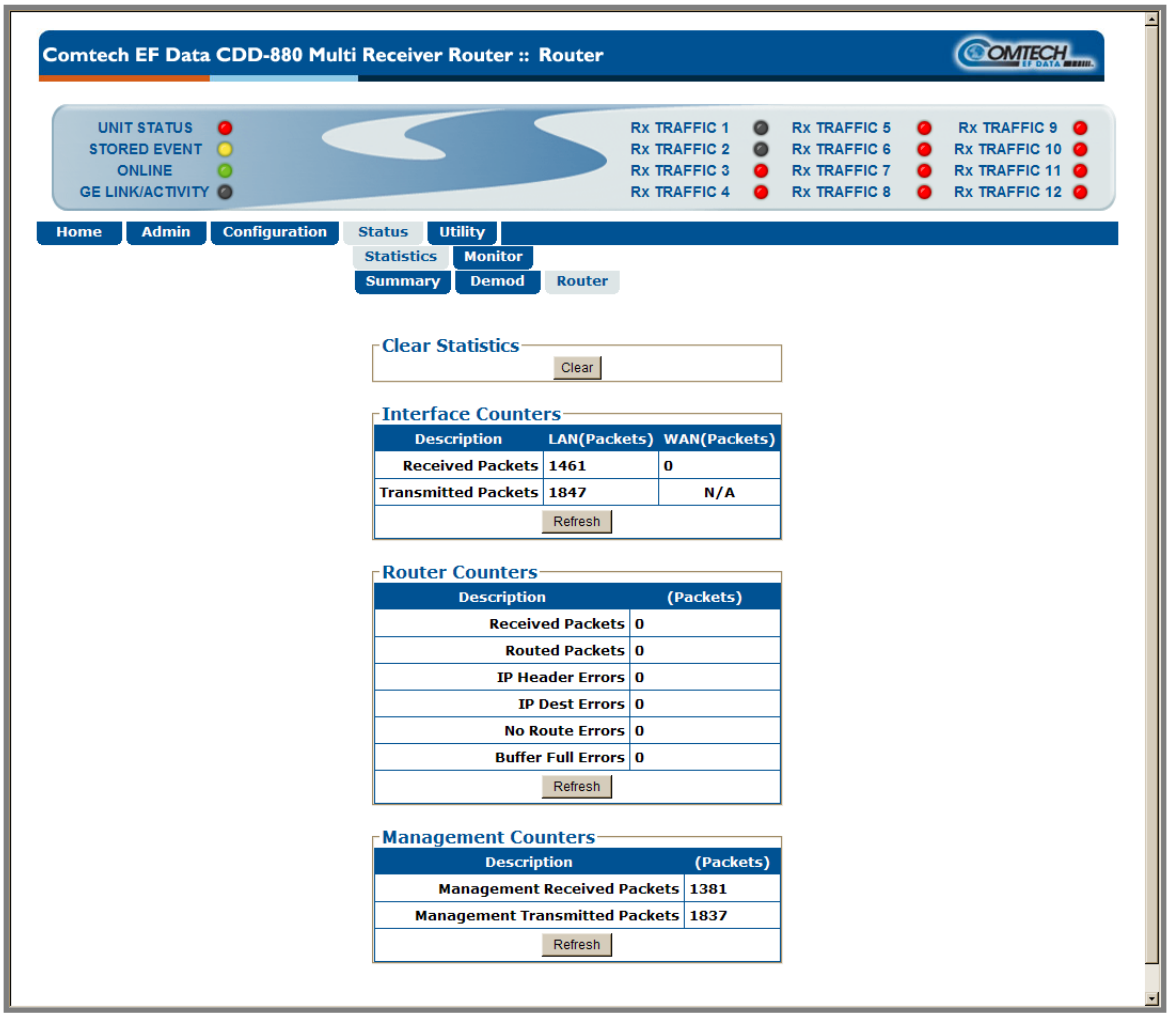


Figure 5-15. Status | Statistics | Router page

The '**Status | Statistics | Router'** page (**Figure 5-16)** is used to view cumulative router traffic information.

Clear Statistics

Click **[Clear]** to clear all router statistics from the buffer.

Interface Counters / Router Counters / Management Counters

For each section, click **[Refresh]** to update the section with its latest available statistics.

5.4.4.5.2 Status | Monitor page

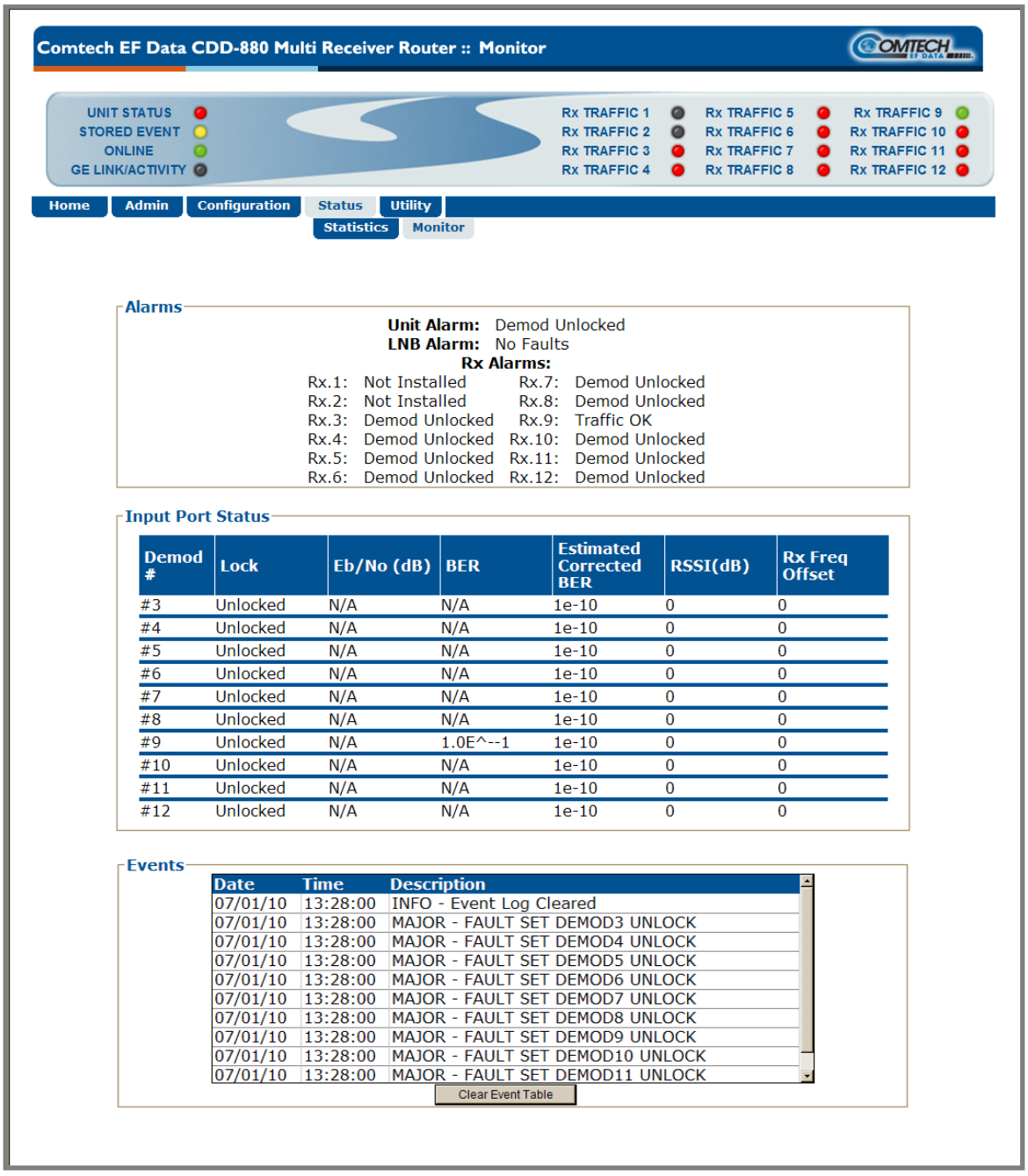

Comtech EF Data CDD-880 Multi Receiver Router :: Monitor
UNIT STATUS
STORED EVENT
ONLINE
GE LINK/ACTIVITY
Rx TRAFFIC 1
Rx TRAFFIC 2
Rx TRAFFIC 3
Rx TRAFFIC 4
Rx TRAFFIC 5
Rx TRAFFIC 6
Rx TRAFFIC 7
Rx TRAFFIC 8
Rx TRAFFIC 9
Rx TRAFFIC 10
Rx TRAFFIC 11
Rx TRAFFIC 12
Home
Admin
Configuration
Status
Utility
Statistics
Monitor
Alarms
Unit Alarm: Demod Unlocked
LNB Alarm: No Faults
Rx Alarms:
Rx.1: Not Installed
Rx.2: Not Installed
Rx.3: Demod Unlocked
Rx.4: Demod Unlocked
Rx.5: Demod Unlocked
Rx.6: Demod Unlocked
Rx.7: Demod Unlocked
Rx.8: Demod Unlocked
Rx.9: Traffic OK
Rx.10: Demod Unlocked
Rx.11: Demod Unlocked
Rx.12: Demod Unlocked
Input Port Status
Demod # | Lock | Eb/No (dB) | BER | Estimated Corrected BER | RSSI(dB) | Rx Freq Offset
#3 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#4 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#5 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#6 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#7 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#8 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#9 | Unlocked | N/A | 1.0E^--1 | 1e-10 | 0 | 0
#10 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#11 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
#12 | Unlocked | N/A | N/A | 1e-10 | 0 | 0
Events
Date | Time | Description
07/01/10 | 13:28:00 | INFO - Event Log Cleared
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD3 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD4 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD5 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD6 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD7 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD8 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD9 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD10 UNLOCK
07/01/10 | 13:28:00 | MAJOR - FAULT SET DEMOD11 UNLOCK
Clear Event Table

Figure 5-16. Status | Monitor page

The '**Status | Monitor'** page (**Figure 5-17**) provides an alarms summary table plus a scrollable ***read-only*** window that displays any events and alarms as logged by the unit during normal operation.

Alarms

This ***read-only*** section provides an overall tally of the **Unit**, **Tx**, **Rx**, and **LNB Alarms** compiled since the logging buffer was last cleared.

Input Port Status

This ***read-only*** section provides, on an *active demod basis*, an overall tally of the parameters compiled since the logging buffer was last cleared. For each active demodulator, note the following:

Lock – VersaFEC decoder lock.

Eb/No (dB) – Estimated channel noise level.

Estimated Corrected BER – Bit **E**rror **R**ate after VersaFEC decoding.

RSSI (dB) – Relative **S**ignal **S**trength **I**ndicator (0 – 60 dB of demod's operating range).

Rx Freq Offset – Estimated offset from demod's configured frequency (in Hz).

Events

Each event or alarm is logged, date- and time-stamped, and a **Description** is provided.

Click **[Clear Event Table]** to delete all existing log entries from the Router Events Log. The log is then reset to one (1) entry: "**Info: Log Cleared**".

5.4.4.6 Utility page

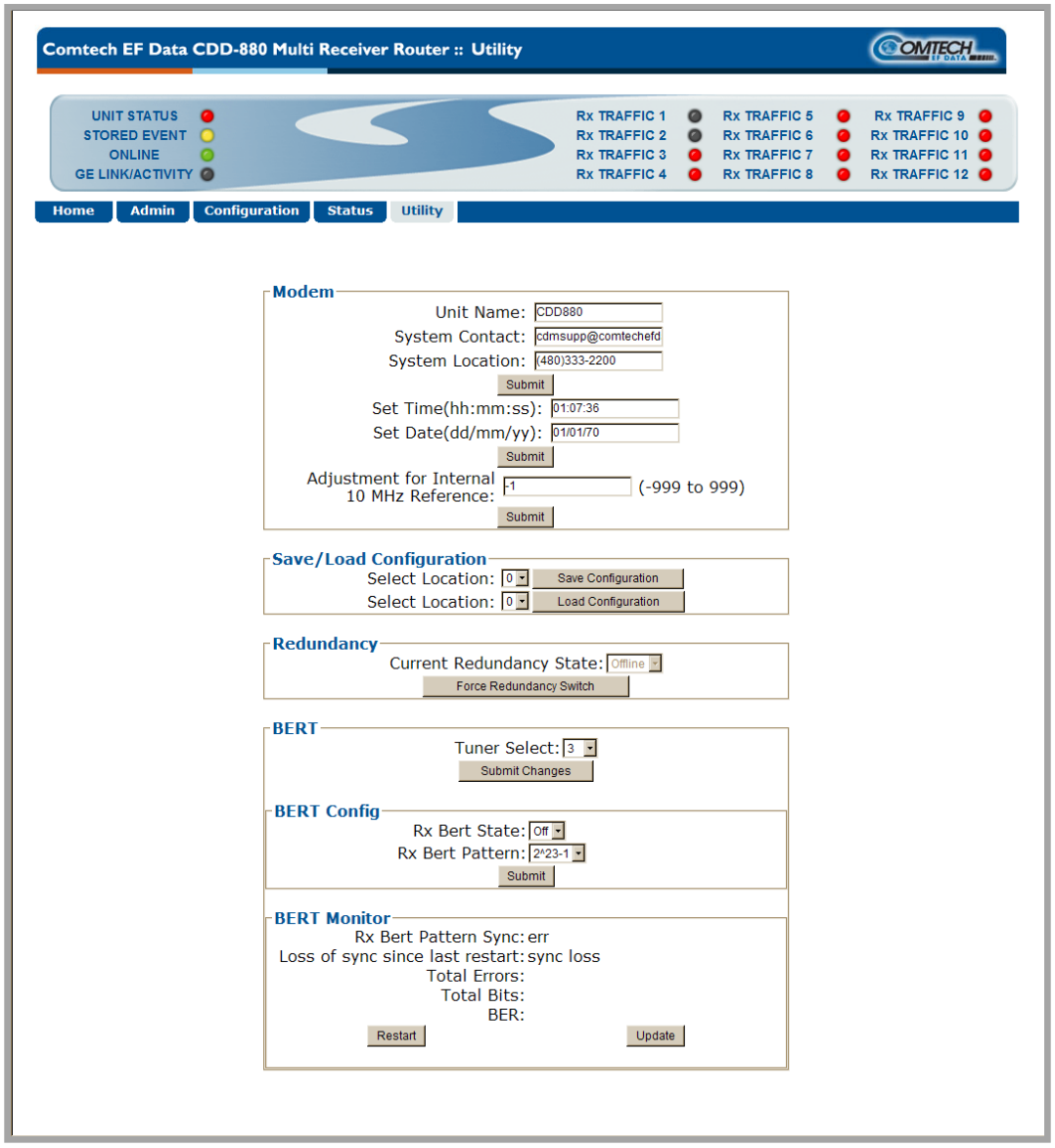


Figure 5-17. Utility page

The '**Utility**' page (**Figure 5-18**) provides an array of top-level system operation controls, configuration storage/selection, and test utilities.

Modem

Unit Name – The assigned product label is identified here.

System Contact / System Location – E-mail and telephone contact information for Comtech EF Data Customer Support are provided here.

Click **[Submit]** once the desired changes have been made to these items.

Set Time (hh:mm:ss) – Enter a time using HH:MM:SS format (where HH = hour [00 to 23], MM = minutes [00 to 59], and SS = seconds [00 to 59]).

Set Date (dd/mm/yy) – Enter a date using the European time format DD/MM/YY (where DD = day [01 to 31], MM = month [01 to 12], and YY = year [00 to 99]).

Click **[Submit]** once the desired changes have been made for the time and date.

Adjustment for Internal 10 MHz Reference – Enter a value from -999 to (+)999, then click **[Submit]** as needed to save this setting.

Save/Load Configuration

This section allows the user to save, then load (recall) up to 10 configuration sets.

To save a configuration set: After all configuration parameters have been adjusted to suit, use the top (Save) **Select Location** dropdown to select **0** through **9**, then click **[Save Configuration]** as needed to store the specified configuration settings.

To load (recall) a configuration set: Use the bottom (Load) **Select Location** dropdown to select **0** through **9**, then click **[Load Configuration]** as needed to recall the selected configuration settings.

BERT

(Where BERT is the acronym for Bit Error Rate Test)

Bert Config – Using the drop-down menus:

- Select the **Rx BERT State** as **On** or **Off**;
- Select the **Rx BERT Pattern** as **2^23-1** (2^{23}-1) or **2047**;

Once the desired BERT settings have been entered in this section, click **[Submit]** as needed to save and execute these changes.

Bert Monitor – This ***read-only*** section displays the ongoing BERT. Click **[Restart]** to restart the BERT Monitor, or **[Update]** to refresh a test already in progress.

Notes:

Chapter 6. FORWARD ERROR CORRECTION

6.1 Introduction

The Forward Error Correction (FEC) method utilized by the CDD-880 Multi Receiver Router is a completely new family of short-block Low Density Parity Check (LDPC) codes with very low latency called **VersaFEC®**. A patents-pending technology wholly owned and developed by Comtech EF Data and CEFD sister division Comtech AHA Corp. (the VersaFEC name is a trademark registered to Comtech AHA), VersaFEC is ideal for lower data rates that demand the shortest possible latency.

6.2 VersaFEC (Short-block LDPC)

While LDPC coding represents a very significant development in the area of FEC and the performance of LDPC is exceptional in terms of coding gain, its higher latency is considered disadvantageous in some applications.

Since the introduction of Comtech's LDPC, considerable research has been carried out to find ways to reduce the block size of LDPC (and hence its latency) while preserving the coding gain performance very close to the Shannon bound.

The VersaFEC code set was developed with two distinct purposes:

1) To provide an expanded choice of combinations of modulation and coding that ***significantly*** reduces latency without compromising coding gain performance.

2) To provide combinations of modulation and coding (***ModCods***) that are not only suitable for Constant Coding and Modulation (**CCM**) applications, but are also the basis for a patent-pending Adaptive Coding and Modulation (**ACM**) system (ACM will be available in future releases of the CDD-880).

VersaFEC represents the best FEC technology currently available, and is offered with a sufficient range of code rates and modulation types that link performance can be optimized under almost any conditions. The performance of the VersaFEC codes compared with the Shannon bound is shown in **Figure 6-1**.

Note that SNR is used in place of Eb/No – a convention for comparing ACM ModCods. SNR is defined as Eb/No + 10_{log}(Spectral Efficiency).

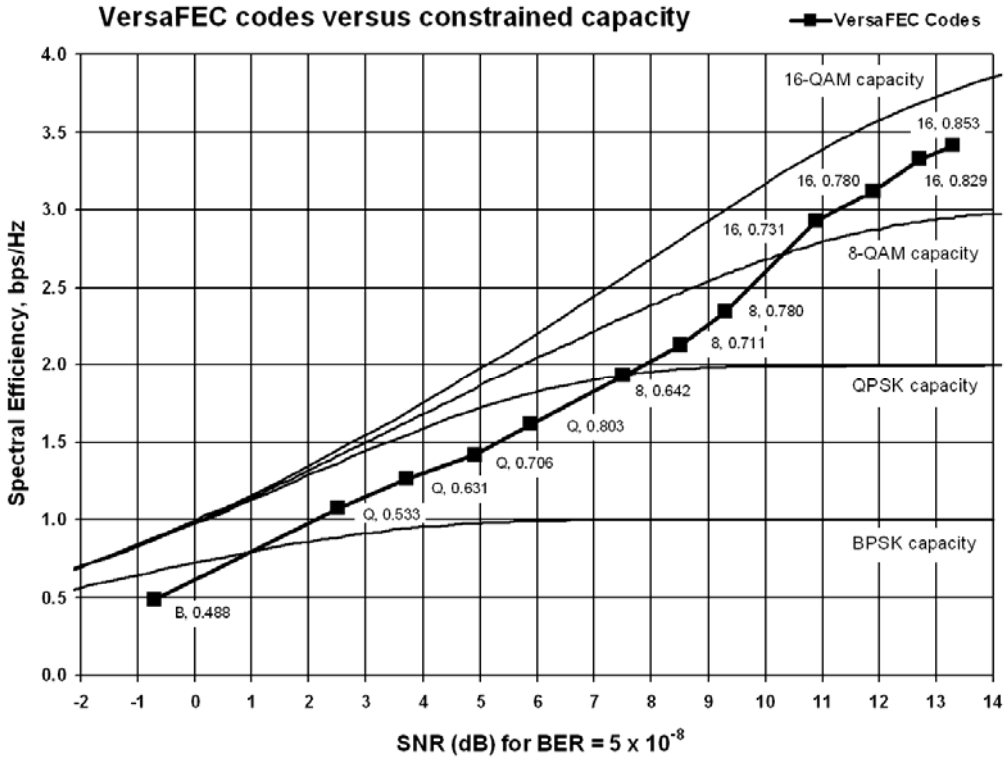


Figure 6-1. The VersaFEC Codes versus Shannon Capacity

There are 12 ModCods in the VersaFEC set (**Table 6-1**). The modulation types (BPSK, QPSK, 8-QAM and 16-QAM) and the code rates have been chosen to give a continuous progression of performance in terms of both Eb/No and spectral efficiency – an essential aspect of a well-engineered ACM system.

Table 6-1. The VersaFEC ModCod Set

Modulation	Code Rate	Spectral Efficiency, bps/Hz	Block size, bits	Typical Eb/No, for BER = 5 x 10^{-8}	Latency at 64 kbps, in milliseconds	Min. Data Rate, CCM mode	Max. Data Rate, CCM mode
BPSK	0.488	0.49	2k	2.4 dB	26	16 kbps	2.19 Mbps
QPSK	0.533	1.07	4.1k	2.2 dB	53	18 kbps	4.80 Mbps
QPSK	0.631	1.26	4.1k	2.7 dB	59	21 kbps	5.67 Mbps
QPSK	0.706	1.41	4.1k	3.4 dB	62	23 kbps	6.34 Mbps
QPSK	0.803	1.61	4.1k	3.8 dB	66	26 kbps	7.22 Mbps
8-QAM	0.642	1.93	6.1k	4.6 dB	89	31 kbps	8.67 Mbps
8-QAM	0.711	2.13	6.1k	5.2 dB	93	35 kbps	9.60 Mbps
8-QAM	0.780	2.34	6.1k	5.6 dB	97	38 kbps	10.53 Mbps
16-QAM	0.731	2.93	8.2k	6.3 dB	125	47 kbps	13.16 Mbps
16-QAM	0.780	3.12	8.2k	7.0 dB	129	50 kbps	14.04 Mbps
16-QAM	0.829	3.32	8.2k	7.5 dB	131	54 kbps	14.91 Mbps
16-QAM	0.853	3.41	8.2k	8.0 dB	132	55 kbps	15.35 Mbps

6.3 CDD-880 Error Performance Characteristics

Figure 6-2 through **Figure 6-5** illustrate the guaranteed error performance characteristics of the CDD-880.

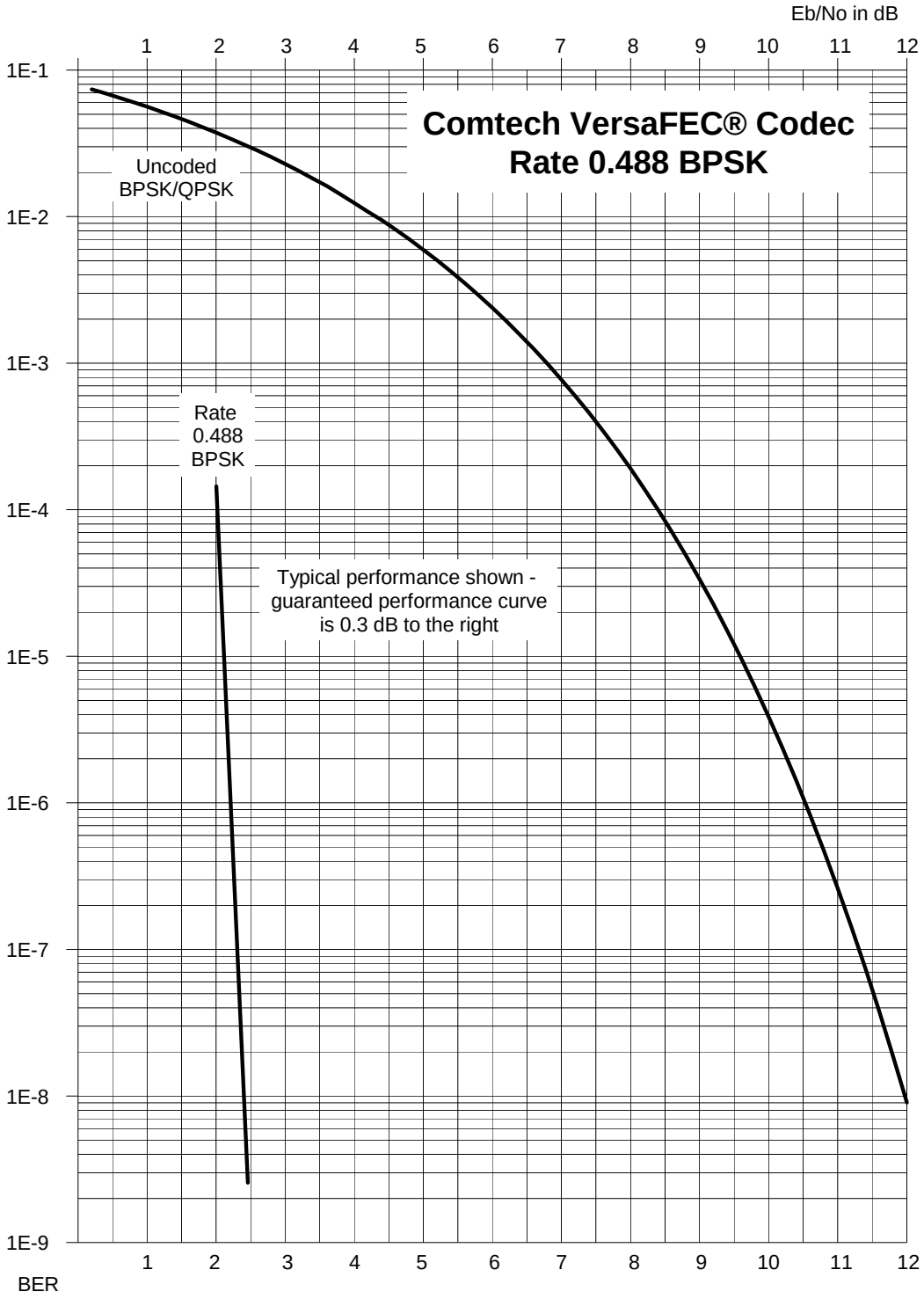


Figure 6-2. VersaFEC Codec – BPSK, Rate 0.488

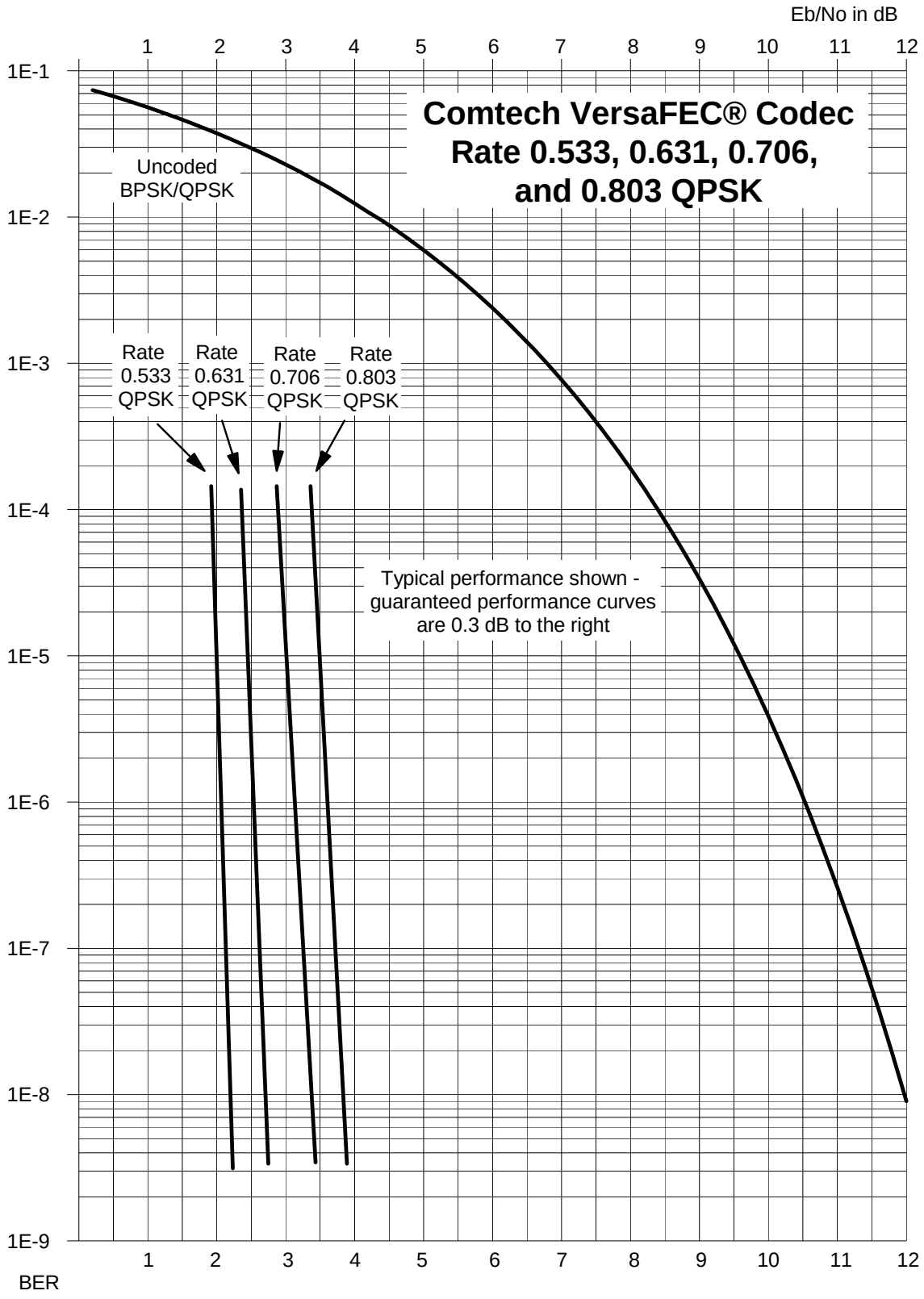


Figure 6-3. VersaFEC Codec – QPSK, Rate 0.533, 0.631, 0.706 and 0.803

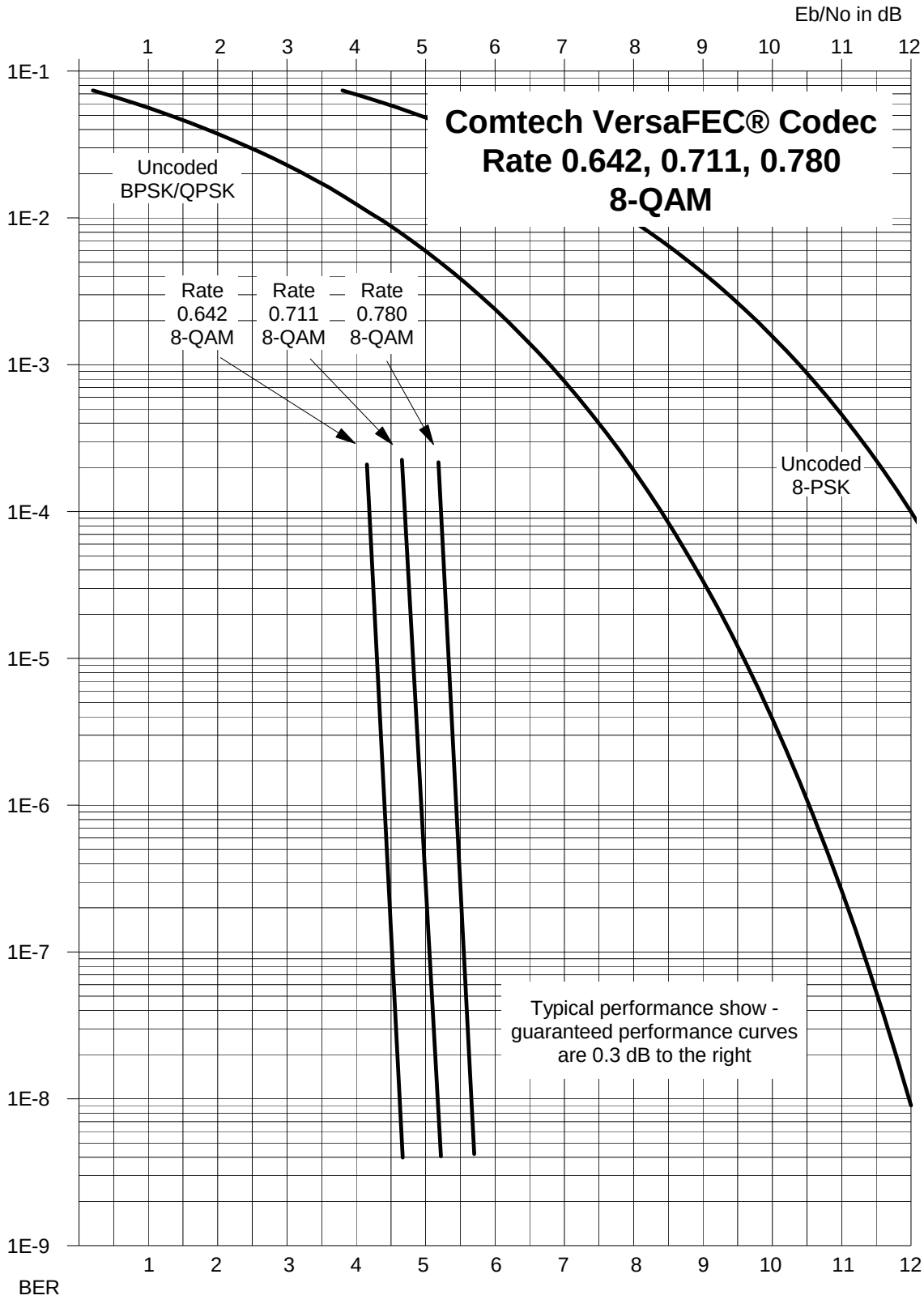


Figure 6-4. VersaFEC Codec – 8-QAM, Rate 0.642, 0.711, and 0.780

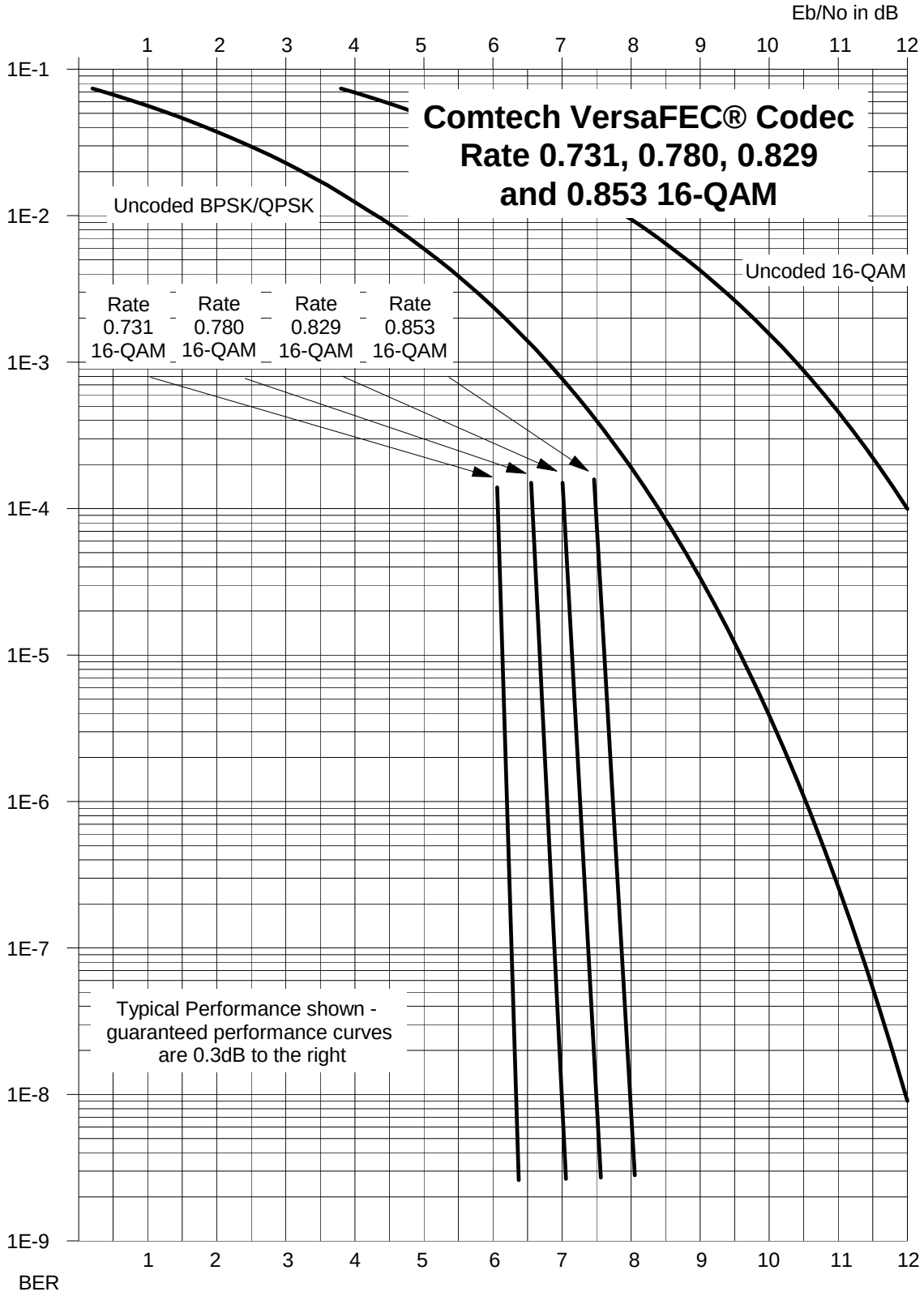


Figure 6-5. VersaFEC Codec – 16-QAM, Rate 0.731, 0.780, 0.829 and 0.853

Appendix A. FAST ACTIVATION PROCEDURE

A.1 Introduction

The CDD-880 Multi Receiver Router is extremely flexible and powerful, and incorporates a number of optional features. In order to permit a lower initial cost, the unit may be purchased with only the desired features enabled.

If, at a later date, the user wishes to upgrade the functionality of a unit, Comtech EF Data provides **F**ully **A**ccessible **S**ystem **T**opology (**FAST**), which permits the purchase and installation of options through special authorization codes. These unique Fast Access Codes may be purchased from Comtech EF Data during normal business hours, then loaded into the unit using the Web Server Interface (accessible via the **MANAGEMENT FE** remote port located on the unit rear panel).

FAST System Theory

FAST facilitates on-location upgrade of the operating feature set without removing a unit from the setup. With **FAST** technology, operators have maximum flexibility for enabling functions as they are required. **FAST** allows an operator to order a unit precisely tailored for the initial application.

When service requirements change, the operator can upgrade the topology of the unit to meet those requirements within minutes. This accelerated upgrade can be accomplished because of **FAST**'s extensive use of the programmable logic devices incorporated into Comtech EF Data products.

FAST Implementation

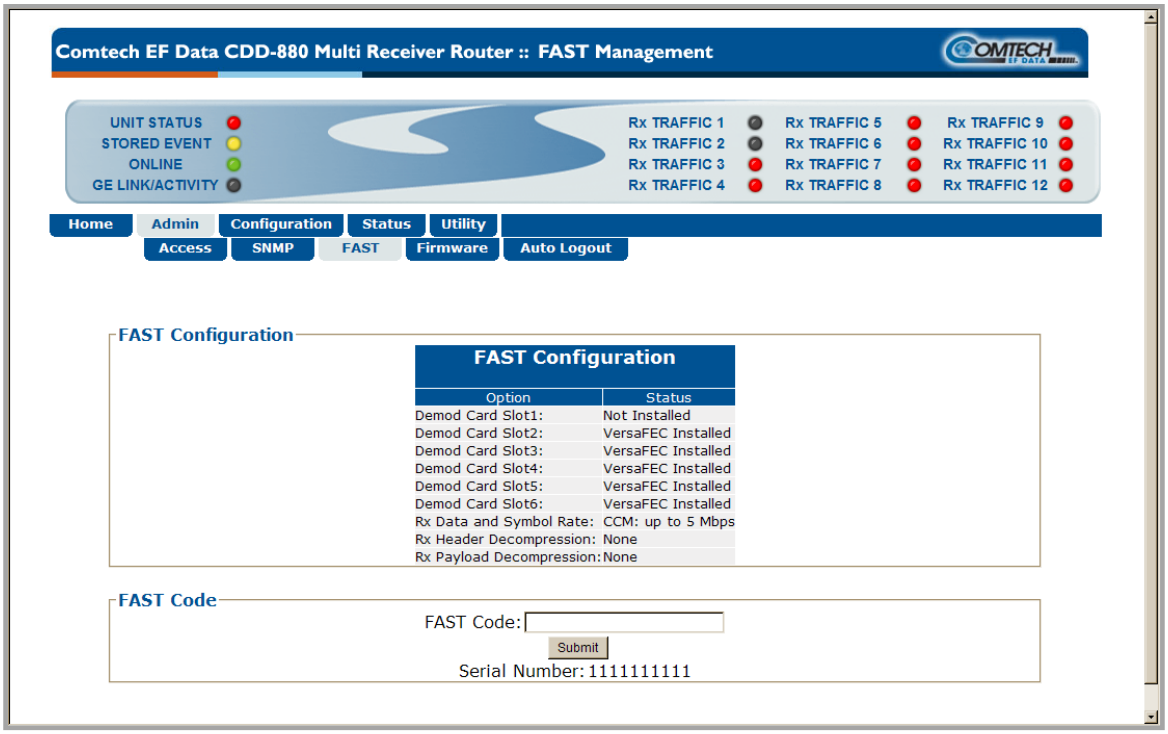
Comtech EF Data's **FAST** system is factory-implemented in the unit. All **FAST** options are available through the basic platform unit at the time of order – **FAST** allows immediate activation of available options, after confirmation by Comtech EF Data, through the Web Server Interface.

FAST Accessible Options

Hardware options can be ordered and installed either at the factory or in the field. In the field, the operator can select options that can be easily activated, depending on the current hardware configuration of the unit. The unique access code that is purchased from Comtech EF Data enables configuration of the available hardware.

A.2 Activation Procedure via Web Server (HTTP) Interface

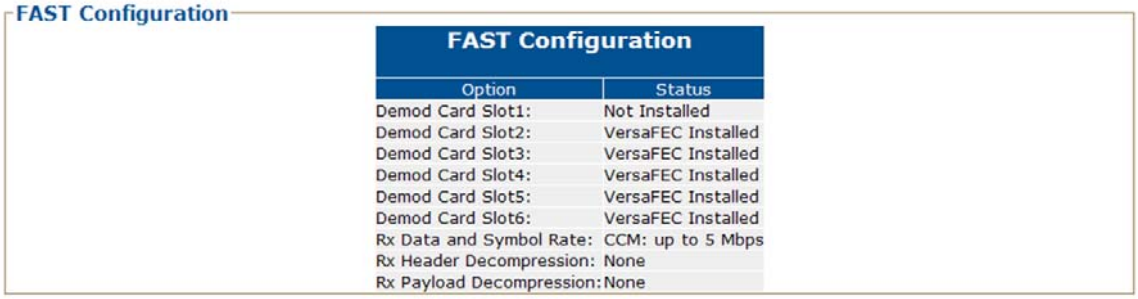
The CDD-880 available FAST options are listed – and the FAST Code entry/option activation controls are provided – via the Web Server Interface on the '**Admin | FAST**' page.



Refer to **Chapter 5.4. WEB SERVER (HTTP) INTERFACE** for a complete overview on CDD-880 operations via this interface.

A.2.1 View Currently Installed Features

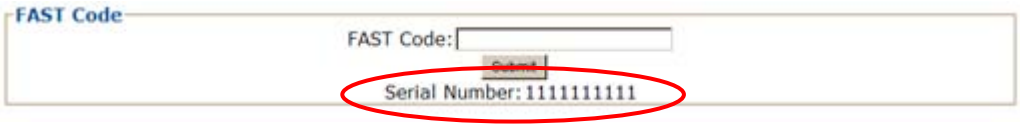
To view currently installed features, the user may refer to the **FAST Configuration** section of the '**Admin | FAST**' page:


FAST Configuration
FAST Configuration
Option
Status
Demod Card Slot1: Not Installed
Demod Card Slot2: VersaFEC Installed
Demod Card Slot3: VersaFEC Installed
Demod Card Slot4: VersaFEC Installed
Demod Card Slot5: VersaFEC Installed
Demod Card Slot6: VersaFEC Installed
Rx Data and Symbol Rate: CCM: up to 5 Mbps
Rx Header Decompression: None
Rx Payload Decompression: None

This *read-only* section displays the CDD-880's available FAST Features and the operational status for each available option. Each available feature is listed in the **Option** column. When an option is enabled, the **Status** column identifies the option as such along with its operational parameter(s); if an option is not enabled, the column will display this information accordingly.

A.2.2 Record Serial Number

When contacting a Comtech EF Data sales representative during normal business hours to order features, the user will be asked to provide the CDD-880's serial number. This serial number is provided in the **FAST Code** section of the '**Admin | FAST**' page:

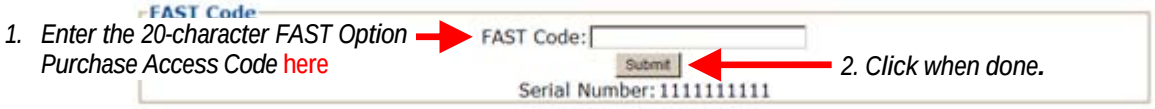


The user should write this number down prior to contacting Comtech EF Data:

Unit Serial Number: _____

A.2.3 Acquire/Enter FAST Access Code

Once a valid unit serial number is provided to and verified by the Comtech EF Data sales representative, Comtech EF Data Customer Support will then provide an invoice, the 20-digit FAST Access Code, and FAST option activation instructions. The user should **carefully** enter the FAST Access Code into the **FAST Code** text box (provided in the **FAST Code** section of the '**Admin | FAST**' page), then click **[Submit]**.


1. Enter the 20-character FAST Option Purchase Access Code here
FAST Code:
Submit
2. Click when done.
Serial Number: 1111111111

A.2.4 Verify FAST Option Availability

If the FAST Access Code is accepted, the page is refreshed once **[Submit]** is clicked, and the **Status** column in the **FAST Configuration** section is updated accordingly.

Notes:

Appendix B. REMOTE CONTROL

B.1 Overview

This appendix describes the protocol and message command set for remote monitor and control (M&C) of the CDD-880 Multi Receiver Router.

The electrical interface is an EIA-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets of variable length in accordance with the structure and protocol defined in later sections.

B.2 EIA-232

This is a configuration in which the 'Controller' device – assumed to be a PC or ASCII dumb terminal – is connected directly to the 'Target' device (i.e., the CDD-880 and its CONSOLE serial port) via a two wire-plus-ground connection. Controller-to-Target data is carried via EIA-232 electrical levels on one conductor, and Target-to-Controller data is carried in the other direction on the other conductor.

B.3 Basic Protocol

All data is transmitted in framed packets as asynchronous serial characters, suitable for transmission and reception to the Controller using a universal asynchronous receiver/transmitter (UART). The character format should be **8N1** (eight data bits, no parity, one stop bit). The baud rate is fixed at **38400** baud. Port flow control should be set to **None**.

The Controller, which is in charge of the process of monitor and control, is the only device that is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the Controller.

All bytes within a packet are printable ASCII characters, less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

With one exception, all messages from Controller-to-Target require a response – this will be either to return data that has been requested by the Controller, or to acknowledge reception of an instruction to change the configuration of the Target.

B.4 Packet Structure

Controller-to-Target						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	 (4 characters)	/ ASCII code 47 (1 character)	 (3 characters)	= or ? ASCII codes 61 or 63 (1 character)	 (n characters)	Carriage Return ASCII code 13 (1 character)

Example: <0000/RSH=30[cr]

Target-to-Controller						
Start of Packet	Target Address	Address Delimiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	 (4 characters)	/ ASCII code 47 (1 character)	 (3 characters)	=, ?, !, or * ASCII codes 61, 63, 33, or 42 (1 character)	 (From 0 to n characters)	Carriage Return, Line Feed ASCII codes 13,10 (2 characters)

Example: >0000/BBU=107[cr][lf]

B.4.1 Start of Packet

Controller-to-Target: This is the character '<' (ASCII code 60).

Target-to-Controller: This is the character '>' (ASCII code 62).

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message.

B.4.2 Target Address

In EIA-232 applications this value is set to 0.

The Controller sends a packet with the address of a Target – the destination of the packet. When the Target responds, the address used is the same address, to indicate to the Controller the source of the packet. The Controller does not have its own address.

B.4.3 Address Delimiter

This is the “forward slash” character '/ ' (ASCII code 47).

B.4.4 Instruction Code

This is a three-character alphabetic sequence, which identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance – e.g., **MLC** for **M**anagement **L**ink **C**onfiguration, **IPA** for Management **IP A**ddress, etc. This aids in the readability of the message, should it be displayed in its raw ASCII form. Only upper case alphabetic characters may be used (A-Z, ASCII codes 65 - 90).

B.4.5 Instruction Code Qualifier

This is a single character, which further qualifies the preceding instruction code. Code Qualifiers obey the following rules:

1. ***From Controller-to-Target***, the only permitted values are:

Symbol	Definition
= **(ASCII code 61)**	The ‘=’ code is used as the **Assignment Operator** (AO) and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument (s) which follow it. **Example:** In a message from Controller-to-Target, IG1= aaa.bbb.ccc.ddd/yy would mean “set the GE Port IP address to aaa.bbb.ccc.ddd/yy”

? **(ASCII code 63)**	The '?' code is used as the **Query Operator** (QO) and is used to indicate that the Target should return the current value of the parameters defined by the preceding byte. **Example:** In a message from Controller-to-Target, IG1? Would mean "return the current value of the GE Port IP address."

2. ***From Target-to-Controller***, the only permitted values are:

Symbol	Definition
= **(ASCII code 61)**	The '=' code is used in two ways: a. If the Controller has sent a query code to a Target (**Example:** CMD? meaning "what's the value of this parameter?"), the Target would respond with CMD=xxx, where xxx represents the parameter in question. b. If the Controller sends an instruction to set a parameter to a particular value, then, providing the value sent is valid, the Target will acknowledge the message by replying with CMD=(with no message arguments).
? **(ASCII code 63)**	If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent is not valid, the Target will acknowledge the message by replying, for example, with CMD? (with no message arguments). This indicates that there was an error in the message sent by the Controller.
! **(ASCII code 33)**	If the Controller sends an instruction code which the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character. **Example:** CMD!
***** **(ASCII code 42)**	If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent is valid, BUT the modulator will not permit that particular parameter to be changed at this time, the Target will acknowledge the message by replying, for example, with CMD* (with message arguments).
# **(ASCII code 35)**	If the Controller sends a correctly formatted command, BUT the unit is not in remote mode, it will not allow reconfiguration and will respond with CMD#.

B.4.6 Optional Message Arguments

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII codes 48 to 57), period (ASCII code 46) and comma (ASCII code 44).

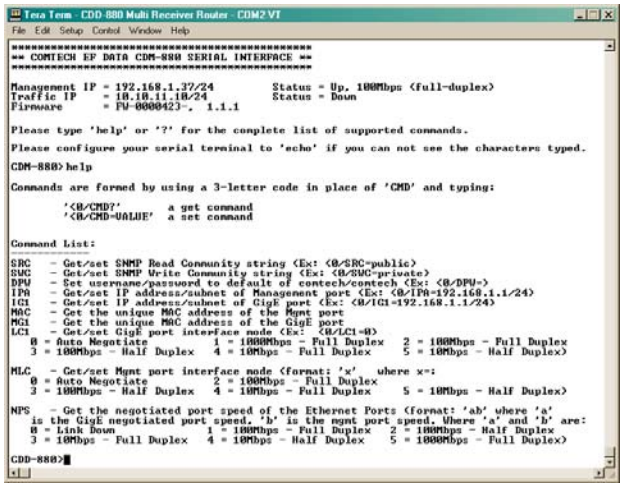
B.4.7 End of Packet

Controller-to-Target: This is the 'Carriage Return' character (ASCII code 13).

Target-to-Controller: This is the two-character sequence 'Carriage Return', 'Line Feed' (ASCII codes 13 and 10). Both indicate the valid termination of a packet.

B.5 Remote Commands and Queries

As explained earlier in this appendix, serial remote monitor and control is accomplished through use of a 'Controller' device – typically a PC or ASCII dumb terminal. An example of such a device is shown to the right. From this interface, the user may type '**help[cr]**' or '**?[cr]**' to display the CDD-880's available commands and queries, and to review instructions for using the interface.


Tera Term - CDD-880 Multi Receiver Router - COM2 VT
File Edit Setup Control Window Help
== COMTECH EF DATA CDM-880 SERIAL INTERFACE ==
Management IP = 192.168.1.37/24 Status = Up, 100Mbps (Full-duplex)
Traffic IP = 10.10.11.10/24 Status = Down
Firmware = FW-0000423-, 1.1.1
Please type 'help' or '?' for the complete list of supported commands.
Please configure your serial terminal to 'echo' if you can not see the characters typed.
CDM-880> help
Commands are formed by using a 3-letter code in place of 'CMD' and typing:
'<0/CMD?' a get command
'<0/CMD=VALUE' a set command
Command List:
SRC - Get/set SNMP Read Community string (Ex: <0/SRC=public)
SWC - Get/set SNMP Write Community string (Ex: <0/SWC=private)
DPW - Set username/password to default of comtech/comtech (Ex: <0/DPW=)
IPA - Get/set IP address/subnet of Management port (Ex: <0/IPA=192.168.1.1/24)
IG1 - Get/set IP address/subnet of GigE port (Ex: <0/IG1=192.168.1.1/24)
MAC - Get the unique MAC address of the Mgmt port
MG1 - Get the unique MAC address of the GigE port
LC1 - Get/set GigE port interface mode (Ex: <0/LC1=0)
0 = Auto Negotiate 1 = 1000Mbps - Full Duplex 2 = 100Mbps - Full Duplex
3 = 100Mbps - Half Duplex 4 = 10Mbps - Full Duplex 5 = 10Mbps - Half Duplex)
MLC - Get/set Mgmt port interface mode (format: 'x' where x=:
0 = Auto Negotiate 2 = 100Mbps - Full Duplex
3 = 100Mbps - Half Duplex 4 = 10Mbps - Full Duplex 5 = 10Mbps - Half Duplex)
NPS - Get the negotiated port speed of the Ethernet Ports (format: 'ab' where 'a'
is the GigE negotiated port speed, 'b' is the mgmt port speed. Where 'a' and 'b' are:
0 = Link Down 1 = 100Mbps - Full Duplex 2 = 100Mbps - Half Duplex
3 = 10Mbps - Full Duplex 4 = 10Mbps - Half Duplex 5 = 1000Mbps - Full Duplex)
CDD-880>

Note the following:

Column 'C' = Command; **Column 'Q'** = Query; columns marked '**X**' designate instruction code as *Command only*, *Query only*, or *Command/Query*.

CODE	C	Q	PAGE
DPW	**X**		B-6
IG1	**X**	**X**	B-6
IPA	**X**	**X**	B-6
LC1	**X**	**X**	B-6
MAC		**X**	B-7
MG1		**X**	B-7
MLC	**X**	**X**	B-7
NPS		**X**	B-7
SRC	**X**	**X**	B-7
SWC	**X**	**X**	B-7

Note – In the tables that follow, the following codes are used in the 'Response to Command' column (as per Sect. B.4.5):

= Message ok

? Received ok, but invalid arguments were found

* Message ok, but not permitted in current mode

\# Message ok, but unit is not in **Remote** mode.

! Invalid instruction code

B.5.1 Unit Parameters

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Default Passwords	DPW=	N/A	Command Only Resets the admin username/password to: Username = “comtech” Password = “comtech”	DPW= DPW? DPW* DPW#	N/A	N/A
GE Address	IG1=	18 bytes numerical	Command or Query. Sets the IP Address and network prefix for the 10/100/1000 BaseT GE1 Ethernet port, in the form aaa.bbb.ccc.ddd/yy, where: (Permitted ranges – cannot all be zero) aaa = 0-223 bbb = 0-255 ccc = 0-255 ddd = 0-255 yy = network prefix (range: 8 to 31) Other restrictions: If aaa>191, prefix may not be less than 24. If aaa>127, prefix may not be less than 16. **Example:** IG1=010.006.030.001/24	IG1= IG1? IG1* IG1#	IG1?	IG1=xxx.xxx.xxx.xxx/yy (see Description of Arguments)
Management IP Address	IPA=	18 bytes numerical	Command or Query. Sets the IP Address and network prefix for the 10/100 Base T Ethernet management port, in the form aaa.bbb.ccc.ddd/yy, where: (Permitted ranges – cannot all be zero) aaa = 0-223 bbb = 0-255 ccc = 0-255 ddd = 0-255 yy = network prefix (range: 8 to 31) **Example:** IPA=010.006.030.001/24	IPA= IPA? IPA* IPA#	IPA?	IPA=xxx.xxx.xxx.xxx/yy (see Description of Arguments)
GE1 Link Configuration	LC1=	1 byte, value 0 thru 5	Command or Query. GE1 Interface mode, where: 0=Auto Negotiate 1=1000Mbps -Full Duplex 2=100Mbps – Full Duplex 3=100Mbps – Half Duplex 4=10Mbps – Full Duplex 5=10Mbps – Half Duplex	LC1= LC1? LC1* LC1#	LC1?	LC1=x (see Description of Arguments)

Parameter Type	Command (Instruction & Qualifier)	Number of Arguments	Description of Arguments	Response to Command	Query (Instruction & Qualifier)	Response to Query
Management MAC Address	N/A	12 bytes, alpha-numerical	Query only. Returns the unique MAC Address for the modem. **Example:** MAC=0006B00001C2	N/A	MAC?	MAC=aabbccddeeff (see Description of Arguments)
GE MAC Address	N/A	12 bytes, alpha-numerical	Query only. Returns the unique GE MAC Address. **Example:** MG1=0006B00001C2	N/A	MG1?	MG1=aabbccddeeff (see Description of Arguments)
Management Link Configuration	MLC=	1 byte, value 0 thru 5	Command or Query. Management Interface mode, where: 0=Auto Negotiate 1=reserved 2=100Mbps – Full Duplex 3=100Mbps – Half Duplex 4=10Mbps – Full Duplex 5=10Mbps – Half Duplex	MLC = MLC? MLC * MLC #	MLC?	MLC =x (see Description of Arguments)
Actual Negotiated Port Speed	N/A	None	Query only. Returns actual negotiated port speed in the form abcd, where: a is the GigE negotiated port speed. b is the management port negotiated port speed. a, b have the following values: 0 = Link down 1=100 Full 2=100 Half 3=10 Full 4=10 Half 5=1000 Full	N/A	NPS?	NPS=ab (see Description of Arguments)
SNMP Read Community	SRC=	16 bytes, characters, no spaces	Command or Query. SNMP read community string. *Empty string is not allowed* **Example:** <1/SRC=public	SRC = SRC!	SRC?	SRC =x (see Description of Arguments)
SNMP Write Community	SWC=	16 bytes, characters, no spaces	Command or Query. SNMP write community string. *Empty string is not allowed* **Example:** <1/SWC =public	SWC = SWC!	SWC?	SWC =x (see Description of Arguments)

Notes:

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Temperature	° Fahrenheit	° Centigrade
Water freezes	32	0
Water boils	212	100
Absolute 0	-459.69	-273.16

Formulas
° C = (F - 32) * 0.555
° F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoirdupois	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

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